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THE
LARYNGOSCOPE.

VOL. LVII JULY, 1947. No. 7

AURAL REHABILITATION. ARMY EXPERIENCE.*

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San Francisco, Calif.

During the recent war years both the Army and Navy demonstrated conclusively that it is practical and sound to treat hard-of-hearing and deafened military personnel in aural rehabilitation centers. When three Army Aural Rehabilitation Centers were established early in the war, it was stated in Army directives that Army personnel who required aural rehabilitation were to be sent to these centers for the fitting of a hearing aid and the teaching of lipreading. Since there was little precedent for aural rehabilitation in the Army, this appeared to be a reasonable procedure. It was evident from the beginning that an aural rehabilitation program that included only the fitting of a hearing aid and the teaching of lipreading was entirely inadequate. The staffs of the hearing centers were given all the encouragement possible by the Surgeon General of the Army to develop methods and technique for a complete, integrated program of aural rehabilitation, including medical and surgical examination and care, the testing of hearing, the fitting of hearing aids, lipreading instruction, auditory training, speech correction, psychiatric evaluation, psychological and vocational counseling, and research.

One of the Army's Aural Rehabilitation Centers was estab-

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lished at Borden General Hospital, Chickasha, Okla., in May, 1943. The growth of this center was steady until in the fall of 1945 a peak load of 611 patients was being cared for. By July 1, 1946, the cumulative total of patients admitted to this hearing center was 4,389 patients. Since the standard length of time for aural rehabilitation was set at eight weeks by Army directives, although modified by the requirements of individual patients, as will be shown later, the closest liaison and cooperation between medical and technical staffs was maintained in order to complete medical and surgical care as well as aural rehabilitation, in the shortest period of time without neglect of any phase of therapy.

The hearing program at Borden General Hospital is outlined below. The descriptions represent the coordinated efforts of many staff members and not of the author alone.

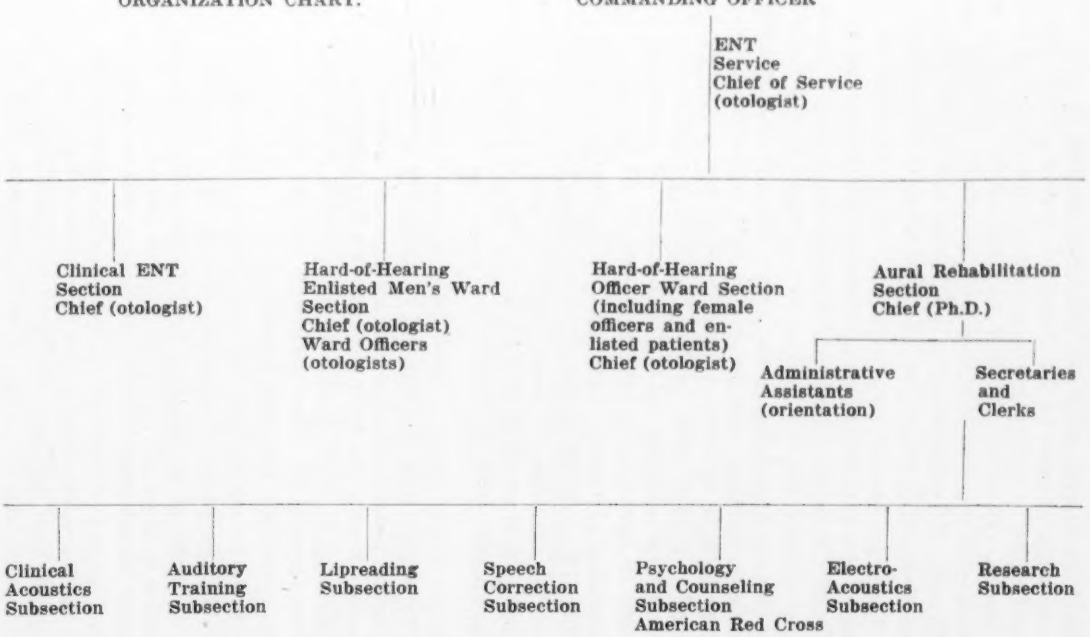
ORGANIZATION.

Most otolaryngological departments in Army General Hospitals are sections of the Surgical Service; however, since aural rehabilitation is a specialized entity, the ENT Section was made a service reporting directly to the commanding officer. In this manner specialized problems pertaining to the program were expeditiously handled. The organization of the ENT Service is outlined on Organization Chart.

The whole organization of the ENT service was designed primarily to treat great numbers of defective hearing patients and yet at the same time to individualize this treatment for all patients. All otologists associated with the program were responsible for the medical, surgical and technical care of all patients within their respective sections, and in addition were responsible for the disposition of patients. Weekly and often daily contacts with patients were made by the otologists. The Clinical ENT Section functioned intimately not only with the hearing program but in addition cared for ENT cases admitted directly to the hospital and those sent from other services within the hospital.

It will be noted from the Organization Chart that the Aural Rehabilitation Section was headed by a Chief of Sec-

ORGANIZATION CHART.


COMMANDING OFFICER
ENT Service Chief of Service (otologist)
Clinical ENT Section Chief (otologist)
Hard-of-Hearing Enlisted Men's Ward Section Chief (otologist) Ward Officers (otologists)
Hard-of-Hearing Officer Ward Section (including female officers and enlisted patients) Chief (otologist)
Aural Rehabilitation Section Chief (Ph.D.)
Administrative Assistants (orientation)
Secretaries and Clerks
Clinical Acoustics Subsection
Auditory Training Subsection
Lipreading Subsection
Speech Correction Subsection
Psychology and Counseling Subsection American Red Cross
Electro-Acoustics Subsection
Research Subsection

tion (also known as Aural Rehabilitation Officer), who was responsible directly to the Chief of Service. This type of organization is highly satisfactory, providing the Aural Rehabilitation Officer is qualified to administer, correlate and advance all the multitudinous technical phases of aural rehabilitation. All subsections in this section had chiefs or supervisors reporting directly to the Aural Rehabilitation Officer.

There are several alternatives in the organization of this section if a qualified Aural Rehabilitation Officer is not available. For example, all subsection supervisors within the Aural Rehabilitation Section could report directly to the Chief of Service, or a qualified person could direct clinical acoustics, auditory training, electroacoustics and acoustical research, while another qualified person could direct lipreading and speech correction, both persons reporting directly to Chief of Service; in addition, in this latter type of organization it would be desirable to have a supervisor of psychology and counseling who would report directly to the Chief of Service.

Regardless of the details of organization, it is emphasized that the activities of each individual unit must be drawn together into an integrated whole so that no phase of aural rehabilitation will be neglected.

PERSONNEL.

During the time this General Hospital was an Aural Rehabilitation Center, 12 otologists were at one time or another associated with the ENT Service. All were supplied by the Army. Six of these were diplomates of the American Board of Otolaryngology. The remaining six had partial training and credentials for their Boards.

The technical staff was obtained from military and civilian sources. Personnel departments within the Army were alert to the needs of the Hearing Centers and sent many qualified persons to them. All civilians received Civil Service appointments. Educational attainments among staff members varied from one to two years of undergraduate training to the Doctor of Philosophy degree. On the whole, 90 per cent of the technical staff had an A.B. degree (or equivalent), or higher. After reporting for duty, all staff members were indoctri-

nated and some even trained in the procedures used in the Hearing Clinic.

STANDARD OPERATING PROCEDURE.

A standard operating procedure for aural rehabilitation was formulated by the staff in the fall of 1944, and was revised on many occasions thereafter to meet changing requirements.

An immediate picture of aural rehabilitation at Borden General Hospital can be sketched in a brief review of the standard operating procedure.

I. Medical Examination and Initiation of Treatment:

A. After routine admission of the patient through the Dispensary and assignment to a hard-of-hearing ward, the following details will be accomplished by the Ward Officer concerned:

1. Medical history and general physical examination.

2. Referral for routine blood and urine studies and serology.

3. Referral for X-rays of mastoids, chest and other regions as indicated.

4. Referral for routine consultations to Ophthalmological and Dental Clinic. Neuropsychiatric consultations are to be initiated on patients presenting neuropsychiatric disorders and other consultations will be ordered as indicated.

B. After the above are completed the Ward Officer will continue the examination of the patient in the ENT Clinic:

1. Detailed and complete history of ear, nose and throat complaints, and of hearing losses.

2. Complete otological examination, including tests of ossicular mobility, fork tests and determination of patency of Eustachian tubes. Vestibular tests will be done when indicated.

3. Complete nose and throat examination, paying particular attention to the nasopharynx.

4. Diagnosis of type of hearing loss, its etiology, and determination of line of duty status. The Aural Rehabilitation Officer is to be notified if, for medical reasons, the fitting of a hearing aid is contraindicated.

5. Prescription and initiation of indicated medical and surgical treatment.

6. Recommendations with respect to supplementary nonmedical phases of the program and orientation of the patient.

II. Technical Examination and Initiation of Treatment:

A. Concurrently with the procedures outlined above, the patient will be processed and examined by the Aural Rehabilitation Section, as follows:

1. The Aural Rehabilitation Program will be individually described to each patient and questions answered. (A booklet, "For Your Orientation in the Hearing Program," will be given each patient.) Appointments for examinations listed in paragraphs 2-7 below will be given.

2. Complete air conduction and bone conduction audiometry.
3. Monaural distance ratios for spoken and whispered speech recognition (Army required). (Here, and in paragraph 2, above, special attention will be given to patients showing evidence of malingering and psychogenic hearing loss.)
4. Tests of visual identification of speech to determine lipreading ability.
5. Speech sound inventory and voice check.
6. Psychological appraisal.
7. Interview by representative of Convalescent Reconditioning Service.

B. On the basis of data collected in Paragraph II, A, above, the examiners will make tentative recommendations with respect to the following phases of the program:

1. Hearing aid, if indicated, including probable type (air or bone conduction) and ear to be fitted. When an air conduction hearing aid is indicated, referral to the Dental Clinic for fabrication of an ear insert will be made, and a temporary hearing aid will be issued for use until the permanent aid is selected.
2. Auditory training, including identification of patients requiring special individual instruction.
3. Lipreading, including the probable duration of instruction.
4. Speech instruction, if indicated (including the type, individual or group correction), or "speech insurance" if indicated.
5. Counseling procedures, including follow-up studies of attitudinal, training and vocational problems.

C. The following procedures then will be carried out by the Aural Rehabilitation Officer and assistants:

1. Data secured under Paragraph II, A, above, and recommendations made under Paragraph II, B, above, will be collected in an individual active patient folder (later to be patient's inactive folder).
2. Data thus secured and recorded will be reviewed, and basic decisions will be made regarding the nature of the patient's technical treatment. In general, the following categories will be observed:
   a. Standard full program. Hearing aid in conjunction with four weeks of auditory training, eight weeks of lipreading instruction, four weeks of "sight-hearing," speech instruction and psychological counseling as indicated.
   b. Abbreviated full program. Hearing aid in conjunction with four weeks of auditory training, lipreading, "sight-hearing," speech instruction and psychological counseling as indicated. Total length, four to six weeks, or longer if indicated. (Factors determining abbreviated full program will be long-standing hearing loss, readily corrected by hearing aid, superior lipreading ability, previous use of hearing aid.)
   c. Special program. No hearing aid (insufficient hearing loss). Intensive instructions in auditory training, lipreading, "sight-hearing," speech instruction if indicated, and special attitudinal counseling. Total length, two weeks. Special program will imply careful daily review regarding possible benefit from hearing aid and consequent revision of program.

d. No program. No hearing aid or program required. Informative interviews and psychological counseling as indicated.

3. Each patient will be informed about appointments for the selection of hearing aid.

4. An individual registration card will be made for each patient, showing classes, hours, classrooms and instructors in the Hearing Clinic, and activity appointments in the Convalescent Reconditioning Unit.

5. Each patient will be individually interviewed, his schedule will be explained and his program will be started. He will be given opportunity for questions leading to the understanding of his program.

III. Review and Confirmation of Medical and Technical Treatment:

A. At the end of each admission week, new patients, admitted during that week, will appear before a Board consisting of the Chief of the ENT Service, the Ward Officers, the Chief of the Aural Rehabilitation Section and Administrative Assistant.

B. The medical history and findings will be presented by the Ward Officer, the indicated medical treatment will be reviewed and its progress checked. The patient will be examined by the Chief of Service.

C. The technical findings and procedures initiated will be presented for review and confirmation.

D. Immediately following this conference, enlisted patients will be transferred to the Convalescent Reconditioning Unit as indicated.

IV. Evaluation of Progress:

A. During each patient's stay in the hospital he will be the object of evaluation, with constant liaison between the medical and technical staffs.

B. The following procedures will be routinely carried out by the personnel concerned.

1. Audiograms will be made when directed.
   a. To evaluate progress of medical or surgical treatment.
   b. To investigate difficulties detected or reported in use of the hearing aid.
   c. To study sporadic, unexplained fluctuations in hearing acuity.
   d. In series for purpose of special study.
2. Progress in the performance and the use of the hearing aid will be periodically checked.
3. Training progress will be checked weekly by examinations and instructor ratings.
4. All personnel will report unusual happenings and attitudes, training failures or abnormal psychological symptoms, to the Chief of the Aural Rehabilitation Section.

V. Final Review and Disposition:

A. On the expected date of the completion of the Aural Rehabilitation Program, the following will be accomplished on each patient:

1. Final audiograms and spoken and whispered voice tests.
2. Final hearing aid evaluation, including instructions for post-hospital maintenance.

3. Final training examinations.
4. Final psychological appraisal.

B. Data from these procedures will be reviewed and necessary action, including further investigation, examination or prolongation of the program, will be taken by the Chief of the Aural Rehabilitation Section. When satisfactory completion of the program will be deemed to have been accomplished, these data will be forwarded to the Chief of the ENT Service.

C. The Chief of the ENT Service, or his associates, will examine each patient individually, will review his entire records and will evaluate his progress for determination of the following:

1. Need for further hospitalization because of medical reasons, either otological or nonotological. Such patients will be reviewed again in the same manner upon termination of the medical treatment.
2. Need for further participation in the Aural Rehabilitation Program. Patients in this category will be reported and reviewed again in the same manner upon completion of further aural rehabilitation.
3. Processing for disposition. (If patient is discharged from the Army, a copy of a booklet, "So He Is Hard of Hearing," will be mailed to the nearest relative at the patient's home.)

All data obtained for each patient was recorded on special forms in duplicate. The original copies were attached to the patient's clinical record, while the carbon copy was filed in the Hearing Clinic. Since Army clinical records are sent either to the War Department or to the Veterans' Administration, this was the only means of securing complete files for the Hearing Clinic.

One of the most constructive and instructive parts of the Aural Rehabilitation Program was the weekly meeting where all new patients were presented and the medical and technical data pooled. These conferences were responsible, in part, for the shaping and developing of the Aural Rehabilitation Program since patient requirements were dealt with in open discussion.

MEDICAL AND SURGICAL CARE.

For illnesses not falling under the jurisdiction of aural rehabilitation, the consultation services within the hospital were generously used. Severe battle casualties, including cases of blindness, those with loss of limbs, etc., associated with deafness of varying degrees, often required specialized treatment before, during and after aural rehabilitation.

The medical treatment of deafness was not encouraging.

Returning war prisoners, especially those from Japanese prison camps who had been subjected to deficient diets and undernourishment, showed no improvement in hearing, audiometrically or otherwise, by correction of diet and supplementary vitamin feeding throughout periods of hospitalization.

Those cases of conduction deafness which were associated with allergy and showed fluctuation in hearing acuity, derived little or no permanent benefit in hearing by allergic therapy.

Loss of hearing associated with catarrhal otitis media (sometimes of several months' duration) was improved on occasion when the fluid was removed and the middle ear remained free of it. The use of thiamine chloride and nicotinic acid was limited to a few cases of nerve deafness associated with either unilateral or bilateral severe tinnitus. Neither the hearing loss nor the tinnitus showed improvement in any patient. It might be noted here that some patients who were fitted with hearing aids, and who complained of deafness, as well as severe tinnitus, mentioned the latter less since the tinnitus was apparently "pushed" in the background; however, at night, when the hearing aid was removed, the tinnitus would return. All patients admitted to the Hearing Center had diagnostic politzerization or catheterization of the Eustachian tubes; these techniques were used also later if indicated therapeutically. The medical treatment of labyrinthian disorders followed accepted principles.

There were 269 surgical operations performed on hard-of-hearing patients from March, 1943, to April, 1946. Twenty-eight of these operations varied from preparations for bronchograms and bronchoscopies to laryngeal polypectomies. The remaining 241 operations are listed below.

Tonsillectomy and Adenoidectomy	77
Tonsillectomy	87
Adenoidectomy	47
Submucous Resection	20
Removal of Foreign Body (plaster external auditory canal)	4
Aural Polyps	2
Mastoidectomy, Complete	1
Mastoidectomy, Radical	3

It can be definitely stated that in certain selected adults with conduction hearing losses, tonsillectomy and adenoidectomy or adenoidectomy alone is a worthwhile procedure. In many of the Army camps soldiers were exposed to inclement weather and, occasionally due to repeated attacks of nasopharyngitis, ear symptoms associated with loss of hearing would develop in some. Upon proper evaluation of their condition in the Hearing Center, often no procedure other than a tonsillectomy and adenoidectomy, or adenoidectomy was necessary to restore the patient to full military duty. Several patients who already had had treatment without success by X-ray irradiation or by radium implantation into the nasopharynx before arriving at the Hearing Center required adenoidectomy. Surgical intervention should undoubtedly have been made before the irradiation therapy was attempted. In four patients, while taking an ear impression in plaster, this material was broken off in the external auditory canal, and the piece of hardened plaster had to be removed under general anesthesia. One patient developed an acute suppurative otitis media, which was undoubtedly the result of traumatic perforation of the tympanic membrane at the time of removal of plaster. These mishaps were traced to errors of technique and could have been avoided.

Many patients with chronic discharging ears were seen in the Hearing Center. The low incidence of mastoidectomies is noteworthy. This can be attributed to the daily meticulous care given to all patients with discharging ears, to the use of chemotherapy and to the proper attention to the nose and throat, including the nasopharynx. Plastic repair of the tympanic membrane aided in healing some traumatic perforations.

The submucous resections of the nasal septum were done purely to insure proper nasal function and not to improve or prevent hearing losses. The Army did not sanction the fenestration operation.

ORIENTATION AND REGISTRATION.

When large numbers of patients are being cared for, it is imperative that each patient be given a comprehensive out-

line of what treatment and management of his case he is to expect at the Hearing Center, and where he should be for appointments, class hours, etc. In this respect a Hearing Center functions not unlike a college or university. Two to four staff members, with adequate secretarial help, spent full time in this administrative and orientation work. A booklet, "For Your Orientation in the Hearing Program," was given to each new patient. This booklet described in detail all phases of the program. It was demonstrated conclusively that an informed patient was a better satisfied patient and, further, that his peformance in the Hearing Center was more efficient.

CLINICAL ACOUSTICS.

This department was concerned primarily with the testing of hearing, the fitting of hearing aids, and the servicing and repair of hearing aids for those personnel returned to duty.

Since the Army required that hearing be tested by the low conversation and whisper tests, one staff member was trained to carry these out. The inadequacies of such testing are well known and will not be elaborated upon here.

All patients received monaural air and bone conduction audiometry. Personnel were trained at the Hearing Center to carry out these procedures, according to the "audiometry standard operating procedure." When many audiograms are being done by different technicians it is essential that all follow certain established techniques if the results are to be comparable. Masking was used routinely for all bone conduction studies, and for air conduction when indicated. "Thermal noise" generators were made for this purpose. All patients had routine audiometry studies upon admission, midway through the program, and before they left the Hearing Center; however, this department was set up so that any number of audiograms could be made on any single patient. Not infrequently patients were subjected to repeated audiometry, in addition to the routine audiometry, because of medical reasons, suspected malingering, psychological reasons, etc.

All members of the medical and technical staff were alerted to detect malingering and functional losses of hearing. Many patients knew certain hearing losses would warrant discharge from the Army, and accordingly simulated hearing losses of varying degrees. In order to cope with this problem, certain features of testing were introduced. When such a problem became acute, as it did periodically, all hearing patients were taken directly from the admitting office for hearing tests even before they were admitted to a hard-of-hearing ward. In most instances this eliminated the so-called "educational factors" by other hearing patients. Discrepancies in repeated audiograms and in speech intelligibility tests were always investigated. In cases of unilateral deafness, a lack of a shadow curve by bone conduction subjected this patient to further investigation. The Stenger test (with modifications) and the Lombard test were used. Monitored "live voice" tests delivered at relative intensities through two matched air conduction receivers to the ears of a patient frequently aided in the detection of malingerers. The so-called "dark room technique" was developed by the staff to help detect either unilateral or bilateral functional hearing losses. In a dark chamber, 22 feet long, hearing distances were determined, monaurally and binaurally, by the spoken voice and whisper. By the examiner occasionally shuffling his feet, the patient would be in no position to judge relative distances. Further, a second examiner often entered the dark room without the patient's knowledge. The malingering patient would invariably respond to cues which he heard and considered were being given by only one close examiner, when in reality the second examiner, standing at a greater distance, was giving the cues. Other malingerers were detected in the dark room even though they knew two examiners were present. It was concluded that no one test is satisfactory for detecting malingering. All who handle such patients must be alert to these special problems, and only after pooling the results of various examiners can the fact of malingering often be established. The same careful attention should be given to cases with psychogenic hearing losses.

The Army permitted the fitting of any hearing aid accepted by the Council on Physical Medicine of the American Medical Association. This gave a wide selection of hearing aids. At no time during the existence of the Hearing Center at the hospital did salesmen from the various hearing aid companies contact the patients. When this Hearing Center was first established, hearing aids were fitted on an informal basis, using ordinary conversational voice. Later this technique was modified. The Hearing Center was indebted for some of these improvements to the staff and personnel at the Central Institute for the Deaf at St. Louis, Mo., who built and installed acoustical equipment. This equipment proved satisfactory in every respect and, above all, it was durable and acoustically accurate, so that it could be depended upon to function day after day for long hours. As more knowledge accumulated about the desired methods for the fitting of hearing aids, the same personnel from the Central Institute for the Deaf improved existing equipment and built and installed new equipment. The Psycho-Acoustic Laboratory, Harvard University, Cambridge, Mass., gave assistance in building and supplying other equipment. The equipment permitted the fitting of hearing aids in the free-field two-room setup, so that various aids could be compared on the same patient.

In a report to the Surgeon General's Office, "History of the Hearing Program at Borden General Hospital," the Aural Rehabilitation Officer, Capt. Grant Fairbanks, M.A.C., summarized the fitting technique that finally evolved as follows:

'In this method the first hearing aid to be tried was adjusted to a preferred loudness for unamplified 'live voice' at a distance of approximately six feet. With the hearing aid at this level the 'detection threshold' was run. This was the minimum power of recorded constant level spondees which the patient was able to hear but not identify. This level was recorded and the volume control on each subsequent hearing aid was adjusted to a point where the same detection threshold was produced. The rationale of this method was the consequent provision of a wider band of frequencies upon which the matching was based (as compared to the 1,000 cycle pure tone matching technique). Immediately upon adoption, it became apparent that this method was far superior, both in the test situation and informally, to the ones previously used. The reliability of this method was found to be high and its validity also superior when checked against the patient's report.

"The final procedure which was used from October, 1945, on, may be summarized as follows:

"With careful standardization of the patient's head position, an unaided binaural pure frequency audiogram was made and the following speech tests were run and results recorded: *1.* 'Detection level,' the minimum level at which words could be detected; *2.* 'identification level,' the minimum level at which words could be identified and repeated; *3.* 'preference level,' the level at which the patient preferred to listen to words; *4.* 'tolerance level,' the maximum level of speech which the subject could tolerate without discomfort. The above measures were expressed in decibels above the normal 'detection threshold.' The first hearing aid was placed on the subject and the volume control adjusted to a preferred loudness for normal speech at a distance of six feet. The four speech tests listed above were run. An additional test, 'identification level in noise,' was made, using a mixture of thermal and static noise approximately 40 db. above the normal threshold. If the hearing aid in question provided the expected gain, two additional procedures were followed: first, the aided pure frequency audiogram with the hearing aid at the established volume control setting; and, second, the identification threshold with the aid at maximum volume setting. When this work had been completed on the first hearing aid, the second instrument was placed on the patient and words were fed into the soundproof room at the level of the detection threshold in the first hearing aid. By adjustment of the volume control on the hearing aid the 'detection threshold' was reached, thus equating the second instrument to the first in gain as far as the detection of speech was concerned. Having thus equated the second instrument to the first, the technician repeated the routine described for the first instrument. This procedure was duplicated on successive instruments. The final decision was made by the technician according to indications supplied by the data thus secured. In the event of substantially equivalent performance on the part of the two different makes of hearing aid, the subject was carefully questioned as to clarity, freedom from noise, naturalness, etc. Also considered was the problem of service, which occasionally became important because of the location of the patient's home or duty station. In all of the procedures described above, an effort was made to prevent the patient from knowing the make of hearing aid under trial at any given time. This was done to prevent bias because of such factors as size, beauty, reputation, etc."

After entering the hospital, patients were not fitted with hearing aids until the preliminary work-up and investigations were completed; during this period of time, usually three to five days, a temporary hearing aid was issued from stock for the patient to wear and acquaint himself with the various parts, mechanism, etc., of hearing aids. This orientation period with the use of a hearing aid was all-important, particularly in subsequent fitting techniques, since most of the patients had never heard sound amplified through a hearing aid. Arcylic ear inserts were made by the Dental Service. Impressions were routinely made of plaster.

For those patients who returned to duty, the Clinical Acoustics Subsection supplied service and repair facilities for all hearing aids issued.

From data available on the fitting of hearing aids up until May 1, 1946, 8 per cent of those fitted were bone conduction types, the remaining 92 per cent being air conduction types. These percentages are based on 2,396 issued hearing aids.

AUDITORY TRAINING.

At the Hearing Center permanent hearing aids were fitted as early as possible, usually three to five days after the patient was admitted; hence, the auditory training program was devised to give as much assistance as possible to each individual user of a hearing aid. Within this department certain instructors were responsible for the supervision of each patient who was issued a hearing aid, and for the servicing of the instrument, including replacement of batteries. A booklet, "Your Hearing Aid," which was prepared by the auditory training staff, describing in detail all parts of the hearing aid, and its use in various situations, was given to each patient. Weekly or daily interviews were scheduled throughout hospitalization, depending on the amount of difficulty each patient was having with his hearing aid. When leaving the hospital a final check-up interview was scheduled.

Group classes in auditory training were organized for the purpose of improving listening ability with a hearing aid.

Only after issuance of the permanent hearing aid were patients placed in these classes. These classes met one hour daily for a period of four weeks.

Group auditory classes were designed to handle large numbers of patients, yet individual needs were not neglected. Course materials were developed by the staff of this department. Speech sound discrimination, speech perception, speech intelligibility, discrimination of reduced clues, connected speech and understanding of speech in noise were all stressed. The use of the telephone with the hearing aid was taught. Lessons in sound localization were presented. Class work was supplemented three hours each week by the "Listening Laboratory." Here, music, life sounds, stories and songs were used.

Certain equipment had to be obtained to carry on such

programs. Recorders and amplifiers and loudspeakers were either assembled or supplied by the Signal Corps. Radios were used to advantage. Often patient talent was used, particularly in the Listening Laboratory. Radio companies were generous in adding discs of all types to the commercially acquired library of recordings.

Individual auditory training was reserved for certain profoundly deafened patients and for patients with nerve hearing losses, who had an unusual amount of difficulty in the use of the hearing aid for reasons of low noise tolerance, or difficulty in speech intelligibility. Patients were instructed daily for as many weeks as necessary. Methods of instruction were individualized, and consisted of presenting amplified speech and music, "live voice" through a speaking tube, "live voice" alone, with or without a hearing aid. Even though some of these patients were extremely deaf, it was the consensus of opinion that the hearing aid was of use to some of them as an adjunct to lipreading.

LIPREADING.

When the Hearing Center was established, each instructor in this department taught lipreading along individual lines. Noting this deficiency, a lipreading course was prepared by the staff. Available methods of lipreading instruction were reviewed, and a basic course of instruction was formulated, including most elements of the English language. This basic course consisted of 24 one-hour lessons. Patients were enrolled in these classes if preliminary work-ups showed need for such instruction. The advantages here were that the patients previously determined to be proficient in lipreading could be started in any phase of the basic course; also, by predetermined lipreading inventories, group classes were made up of various patients with comparable abilities. Early in the development of the Hearing Clinic the basic lessons were given individually; however, as the patient load increased, classes in basic instruction were made up of several "matched" individuals. This was found to be a desirable plan for instruction. After completion of the basic course, which covered four weeks, during which time teachers were

changed, the patients were moved into advanced lipreading. This was taught one hour daily throughout the rest of the patient's stay in the hospital, usually in 16 lessons. All instruction was integrated so that there was a continuous progression of efficiency in lipreading ability. During the last four weeks of aural rehabilitation, in addition to the above instruction, patients were enrolled in "sight-hearing" classes. In these classes the patients wore hearing aids. Motion pictures with and without sound were shown. Some classes were held with interfering background noises. A definite course of 20 one-hour lessons was developed by the staff, covering many conceivable true-life situations. This was an attempt to correlate and synthesize all previous training given in the Hearing Center by the use of both visual and auditory senses.

SPEECH CORRECTION.

One might wonder why speech correction was a portion of the Aural Rehabilitation Program when patients admitted to the Center were supposedly all recently deafened. When one considers that of 3,917 patients processed through the Hearing Center at the hospital prior to July 1, 1946, 51 per cent of them had hearing losses before they entered the Army, it is evident that many of them would have voice and articulatory disorders related to hearing losses. Then, too, some patients with recent blast deafness showed voice disorders.

Soon after admission to the hospital, as noted in the standard operating procedure, voice and articulatory inventories were obtained from each patient. Those with mild voice and articulatory disorders were placed in group speech correction classes one hour daily for varying periods of time (average, three to six weeks). Those having more pronounced voice or articulatory disorders were taught individually each day. By use of the tape recorder, supplementary training was given. Patients in whom it could be shown audiometrically and by interview that they had difficulty in hearing their own voices were placed in so-called "speech insurance" group classes. These classes met daily for one hour for four weeks. The

purpose of "speech insurance" was to avoid future voice and articulatory disorders which, although not present at the time of aural rehabilitation, might develop later. Nonauditory techniques in articulation and voice placements were used.

PSYCHOLOGICAL AND VOCATIONAL COUNSELING.

Psychological problems and psychoses occur in the hard of hearing and the deafened. In the age groups dealt with in the Hearing Center, psychoses and psychoneuroses in the deaf were found to be no more frequent than in the comparable groups of non-hard of hearing. Tension, anxiety and withdrawal were symptoms frequently encountered.

The staff of this department prepared a Hearing Attitudinal Scale, with which each new patient was tested. After evaluation of this scale, a personal interview was given each patient regarding his individual problems. In this manner, those patients presenting problems were spotted early and were interviewed further as necessary throughout aural rehabilitation. Many superficial psychological problems could be dealt with in this manner. If psychiatric evaluation was necessary, this was obtained. The psychologists also had at their disposal a battery of standard psychological tests to be used when indicated. Psychological and vocational counseling was given either in groups or individually, depending on the individual's need.

In conjunction with the neuropsychiatric section, narcosynthesis for hysterical deafness was first employed late in 1944. Pentothal sodium intravenously was the drug most successfully used.

The American Red Cross functioned intimately in conjunction with the Hearing Clinic. Routine as well as specialized services that pertained to problems of the hard of hearing were rendered. Red Cross workers, not directly assigned to the Hearing Clinic, were instrumental in developing entertainment programs and social activities. This was considered a very important part of aural rehabilitation since patients

were thus encouraged to meet new situations and get out of the "hospital atmosphere."

LECTURE SERIES.

All hard of hearing patients attended a one-hour lecture weekly in addition to their regular training program. These lectures were designed to orient the patient and further aid in his complete integrated aural rehabilitation. The lectures were given by medical and technical staffs, and may be summarized as follows:

Lecture 1: Medical and surgical aspects of hearing loss. Anatomy and physiology of hearing. Etiology of hearing losses.

Lecture 2: Acoustical characteristics of hearing loss. Methods of testing hearing, and their significance. Relation of hearing losses to hearing aids. Variations of different hearing losses, and their meaning. Individual patient's audiograms shown.

Lecture 3: Hearing aids were discussed, as well as their methods of selection. Acoustical corrections expected were taken up. Patients were quizzed orally regarding their individual hearing aids.

Lecture 4: Attitudinal counseling. Employer-employee situations with class participation.

Lecture 5: Attitudinal counseling. Class characterized social situation with discussion.

Lecture 6: Vocational counseling. Limitations regarding occupations for hard of hearing, GI Bill of Rights and Public Law 16.

Lecture 7: Hearing Attitudinal Scale, retesting and open discussion on any phase of aural rehabilitation.

SPECIAL PROGRAM.

Many patients entered the Hearing Center who did not have sufficient hearing losses to warrant standard or abbreviated full aural rehabilitation. These patients were invariably ill-adjusted to Army life, although their hearing losses may have been slight to moderate. Others had hearing losses that were undoubtedly a serious handicap in the performance of Army duties, yet their hearing losses were not of sufficient degree to warrant the use of a hearing aid. For example, some had unilateral hearing losses, some had moderate losses bilaterally, while others had a severe unilateral deafness with mild loss of hearing in the other ear. Another very important factor was that many of these patients had hearing that met either full or limited duty requirements. The problem, then, of the

Hearing Center was to devise a program wherein this rather large group of patients could be sufficiently adjusted to return to and continue duty. To meet these problems, the Special Hearing Program was devised early in 1945.

A total of 599 patients were processed in this type of program prior to July 1, 1946. Some of these patients, after a careful period of observation, were moved into the standard full program.

The length of this program was two weeks. Instruction was carried out three hours each day. Specialized adaptation of auditory training, lipreading and "sight-hearing" were woven into a smooth, continuous integrated pattern. Instructors were specially trained for this teaching.

The psychology and counseling department devoted many hours both to individual and group instruction for this group. Parts of the lecture series were often attended by these patients.

ELECTROACOUSTICS.

In a Hearing Center, a group of persons must be responsible for the maintenance of present and development of new equipment. All electroacoustical equipment requires constant revision and calibration. Members of this department, if qualified, can be of the greatest value in the smooth functioning and progressiveness of the hearing center.

RESEARCH.

Providing the clinical load permits it, certain qualified individuals can be strategically placed to carry on research in various phases of the hearing program. In all portions of the hearing program previously described, validation of current methods can always be subject to review. Statistics accumulate rapidly in a hearing center. New instrumentation comes only through thorough and complete research.

SUMMARY.

As stated previously, 3,917 patients were completely processed at the Hearing Center prior to July 1, 1946. A total of 4,389 had been admitted by this date, meaning that part of

the remaining 472 patients were still in training, and that records of others were not completed for statistical purposes. Figures available for the 3,917 patients show that approximately 44 per cent received standard full aural rehabilitation. Most were trained for eight weeks, while a few seriously handicapped received instruction up to 12 weeks; 22 per cent received the abbreviated full program, the training varying from one to seven weeks. Fifteen per cent were enrolled in the special program, while another 15 per cent needed no instruction. In this latter group were patients with chronically discharging ears; those who had received blast injuries to the ears but had regained their hearing; those with traumatic perforations of the tympanic membrane; those with labyrinthian disorders, etc. Of the remaining three plus per cent, 14 refused training; the remaining patients showed "no records."

It is evident that an Aural Rehabilitation Program must be flexible so that various types and groups of patients may be instructed according to their needs.

Medical and surgical care should be included as an integral part of the Hearing Center.

Research to improve and expand present methods of aural rehabilitation should be continued.

The length of the training program can be predicted, providing that enough fundamental preliminary data are procured for each patient, thus assuring that individual requirements are met.

The Army presented unique facilities for complete integrated rehabilitation, and no doubt hearing centers for civilian use will be patterned along similar lines.

Full acknowledgment for the success of the Hearing Program at Borden General Hospital is given not only to the commanding officer of the hospital but to the many medical and technical staff members who wholeheartedly and diligently served at this Hearing Center.

PROGNOSIS IN THE HARD-OF-HEARING CHILD.*†

D. E. STAUNTON WISHART, B.A., M.D.,
Toronto, Canada.

In attempting prognosis regarding a hearing-deficient child, the otologist must approach the patient in a proper frame of mind, must have the means and environment for measuring the hearing, must be prepared to examine the patient many times before expressing a final opinion, and must do the work himself.

The Attitude of the Otologist.

The attitude of the otologist is of supreme importance. The prevalent point of view is defeatist, whereas it should be hopeful.

In 1945, Lurie[1] presented a condensed, comprehensive, valuable paper on the causes of deafness and what can be done about it. The facts supporting his views are, to the best of my knowledge, still uncontrovertible. They were, in the majority, pessimistic in the extreme. The author stated that he had been pessimistic purposely. He closed with the statement that a great deal will be done for the deaf but it will not be done by the otologists.

That paper deserves to live because it warns medical men against the quackery that still thrives in the field of treatment for early deafness.[2] I hope it will form a chapter in every textbook of otology; but in spite of this warning, our better otological journals continue to publish papers advocating treatments for deafness on very insufficient grounds. On the other hand, if we blindly follow those pessimistic arguments we will be hopelessly prejudiced in our approach to the problem of deafness in children.

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Such an approach — although it seems logical — I believe is wrong, for I rather hold with Grove[3] that, whereas the majority of the hearing defects of adults are fixed in character, this is not true among children. It is in this group that the otologist finds his greatest opportunity for real conservation of hearing. I hold that the otologist can and must do a great deal for children with defective hearing.

Those who work with children hardly need be told that one of the qualities of childhood is an amazing power of recovery — a power of recovery which the adult does not possess. Nearly every pathological process consists of numerous stages and in many of these stages the process may be arrested and complete restoration to normal result. It is not inevitable that the stage of irreversibility be reached. This is the attitude in which the problem of deafness in the child should be approached.

The Means and Environment for Testing Hearing.

Methods of relative precision suitable for a child should be used for testing the hearing under conditions capable of being repeated fairly exactly on future occasions, but the testing of hearing is at present in a state of chaos. Opinions regarding technique are many and various; witness many articles on the subject by various eminent authors in one of the latest textbooks.[4]

The testing of hearing requires simplification and standardization. Recognition of this fact is arousing intense research. Many of the present schemes require long, arduous testing of the patient. Expensive installations and elaborate research programs can be found in operation at several great universities and hospitals. The establishments are comparable to the expensive and ever-improving X-ray departments in hospitals throughout the country.

Some authorities believe that the testing of hearing will everywhere require similar elaboration and expense and that eventually it will pass from the hands of the practicing otologist and be confined strictly to expensive hospital departments devoted to the testing of hearing.

Others, on the contrary, believe that a much simpler, quicker and less expensive scheme can and will be devised.

Mechanisms Required for Testing Hearing.

a. For the measurement of the threshold hearing for pure tones the approved pure-tone audiometers sufficiently meet our requirements.

b. For the measurement of the hearing of speech there is no standardized quick, simple method.

Why the Pure-Tone Audiometer Fails.

The pure-tone audiometer enables the determination of how well the ear perceives a few octaves of pitch,[5] but hearing is not so simple. We hear — not single tones — but sound patterns, and the flash images that are produced are complex pictures. It takes two years of beginning life to develop even a memory of these sound pictures. Pitch hearing-testing tells us nothing as to how well speech is heard. Much needless futile, foolish effort has been made to correlate the findings of the phonograph audiometer and the pure-tone audiometer. Some workers have prided themselves with finding a correlation factor. How utterly foolish! What does the correlation factor do for the otologist or the patient? The two types of audiometers test different things. There is plenty of evidence to show that definitely it is impossible to determine how well a person hears speech from studying a frequency audiogram. Basically and finally, it is speech with which we as otologists are concerned.

The pure-tone audiometer has become recognized as a reliable means of estimating a patient's threshold hearing of discrete tones. From this, the confident but erroneous belief has arisen that a patient's true hearing has not improved unless his audiometric curve has improved appreciably. The belief is widespread — but it is not correct.

There are patients who were hard of hearing and in consequence unable to continue in secretarial employment, who, since fenestration, are carrying on successfully as stenographers. For some of these the pre- and postoperative audio-

grams remain approximately the same; therefore, skeptical otologists refuse to admit that the hearing of these patients really has improved and variously explain the phenomenon of employment.

Conversely, if a patient who has lost his employment because of deficient hearing has the same audiogram as he had when employed, our skeptics maintain that this disability is psychological only.

How stupid! The former do hear speech better and the latter hear speech less well than they did previously.

The error lies in undue emphasis on threshold hearing. It cannot be stated too emphatically that threshold hearing for tones is not hearing for speech.

Recognition of this truth has led to intense efforts to develop methods for testing the hearing of speech. The emphasis at present is on the search for a suitable list of words which will be accepted universally.

Gramophone Recordings for Testing Hearing for Speech.

The reader is referred to papers by Macfarlan[5] and by Hudgins, *et al.*,[6] for a wealth of information on the testing of hearing for speech. Many of the statements which have been made and which follow are taken from these sources. We are indebted profoundly to many patient workers for their attempts to produce lists of words and sentences suitable for the phonograph testing of speech.

Two relatively new phonographic recordings have been developed at the Psycho-Acoustic Laboratory, Harvard University, and may be obtained from Central Institute for the Deaf, 818 South Kingshighway, St. Louis, Mo. The words used are selected spondees; that is, words of two long syllables which are equally emphasized. They are divided into seven groups of six words each, and each group is recorded at progressively lower intensity levels, 4 db. apart. Thus, the range of levels on the records is 24 db. The words are recorded at six-second intervals, which allows time for writing them. Each list is recorded on six scrambled versions, making 12 equivalent forms of the test.

For testing hearing losses greater than 24 db., amplification must used.

These recordings will doubtless become standard usage for all great hospitals developing the hearing-test units envisioned above.

The writing of such words takes education, intelligence and time, and in my opinion is still too elaborate for the purpose of testing hearing in children. It rules out patients below a certain age and mentality. It does not take into consideration the fact that inflection, accent, dialect and many other subtle characteristics of speech vary according to localities,[5] nor the foreign language accents shown by some of our second generation immigrants.

The practicing otologist has a much simpler apparatus available. The 4A audiometer, with its valuable records, has been neglected and maligned chiefly because it has been used as a group screening test by lay personnel in surroundings which defied the most elementary acoustics.

Certain clinics, however, have used this apparatus under good conditions for testing individual patients for losses of hearing as high as 70 db. It is probable that an improved form will shortly be on the market for use by otologists in quiet or so-called soundproof rooms.

The advantages and disadvantages of this neglected test have been admirably set forth in the report[6] of the research performed at the Psycho-Acoustic Laboratory, Harvard University.

"The Western Electric 4C test (the 4C is the present form of the 4A) when used with high-fidelity play-back equipment gives a reliable measurement of hearing loss in spite of the fact that the seven digits which make up the test contain only seven vowels and nine consonants.

"The 4C audiometer has many merits. The simplicity of the standard equipment offers no technical problems for its administration. The familiarity of the test items (spoken digits) renders it possible to test pupils in the lowest primary

grades. The test is easily scored by means of prepared forms and a scoring stencil.

"The limitations of the 4C lie largely in the limited range covered by the fixed-gain play-back equipment and the relatively few speech sounds sampled. Since no particular vowel occurs more than once in the series of numbers chosen, recognition depends almost solely upon the identification of individual vowels rather than upon consonants. This, however, is not a serious limitation in measuring the hearing loss for speech unless we are concerned with the diagnosis of high-frequency hearing loss. Test items which are recognized by vowel content alone will not differentiate between an ear having a uniform hearing loss and one having a severe high-tone loss."

This research team showed great ingenuity and perseverence in developing the two new test lists already referred to for the purpose of that differentiation. They were confronted by the fact that most telephone receivers pass only frequencies below 3,000 c.p.s.; however, after all their work they conclude that, in its present form, the high-frequency test offers no real advantage over the pure-tone audiometer as a diagnostic instrument.

It is, therefore, my opinion that — until new apparatus is devised — the 4A audiometer is all that is necessary for testing the hearing of children's speech.

Equipment Recommended for Testing Hearing of Children.

I, therefore, recommend that the practicing otologist provide himself with:

1. A pure-tone audiometer of approved type, and

2. A phonograph audiometer with two recordings: *a.* the Western Electric two-digit record K.S. 10087; and *b.* one of the Harvard records mentioned above.

Essentials of a Scheme of Testing Hearing.

The mere possession of these instruments is no guarantee that they will be used properly or in the proper environment.

1. A quiet room is necessary — for otherwise the lowest speech intensities will be masked, giving a spurious threshold.[6] In order to avoid the hum present in some pure-tone audiometers it may be necessary to shield and ground the apparatus. The noises made by the pickup of the gramophone audiometer do not disturb a patient if the essentials numbered two and three are used.

2. The testing sounds should be transmitted to the patient through earphones. (These are less expensive, more dependable and more accurate than the loud speaker. The more elaborate the apparatus the more there is to get out of order.) These require a uniform frequency and an impedance characteristic between 100 and 400 c.p.s.[6] They should be used with a tight-fitting earphone cushion held in place by a headband.

3. Ordinarily one ear is tested at a time. In this case the headbands should be equipped with one active earphone with a snugly fitting cushion over the ear to be tested and a second earphone (which is fitted for masking when that is required) with a similar cushion over the contralateral ear.[6]

4. When the pure-tone audiometer is being used, the patient should sit with his back to the examiner. A simple photograph (see Fig. 1) of this arrangement should have a place in every textbook. Instead of this the physician finds, in other literature, an illustration showing testing done in an open office, without the untested ear covered, and with the patient watching every move of the examiner. One good picture is worth many pages of writing. One bad picture perpetuates evils.

5. The pure-tone audiometer should be used as detailed by the late Walter Hughson.[7]

6. Rely on the two records already suggested. The examiner is interested in measurement for purposes of comparison; therefore, keep the means simple.

The Results Obtained by These Tests.

When a child has been examined and tested, the first

conclusion that should be made is whether the patient is deaf or hard of hearing. A proper understanding of these terms is essential. They should be used strictly as recommended by our Society. The American Otological Society, Inc., in 1940,[8] resolved that the terms "deaf" and "deafness" should be reserved for designating loss of usable hearing for the ordinary purposes of life for the individual; lesser degrees of auditory

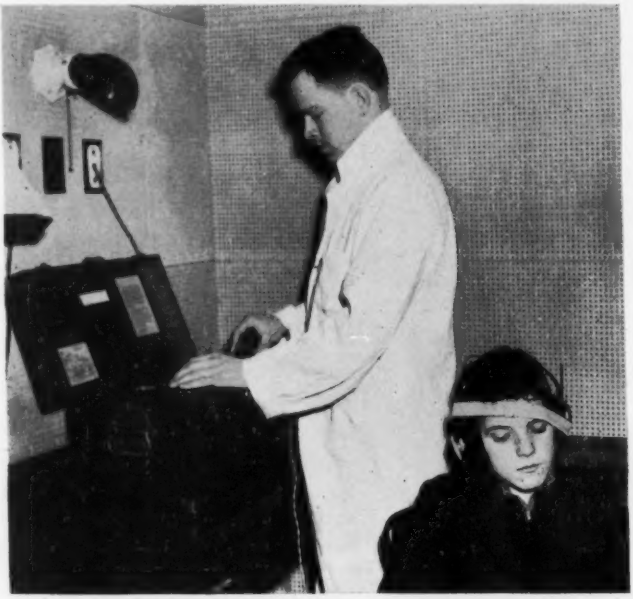

Fig. 1. Correct method of performing pure-tone test.

loss should be designated as hearing impairment and individuals having such impairment should be classed as hard-of-hearing or hearing-deficient persons. This paper deals with —not the deaf child — but the hearing-deficient child.

Both tests should be repeated at least once within a short period. It cannot be too emphatically stated that in the majority of instances the tests do not reveal the location or

the nature of the hearing lesion. Together they form a record of the state of the patient's hearing on a certain date. One of them gives a valuable indication of the patient's ability to understand speech. They are for comparison with tests done at a later date by the same technique and with the same apparatus under identical conditions.

Fig. 2. Incorrect method of performing pure-tone test.

It is in this comparison that the value of the testing lies.

The patient should be retested when the parent thinks the child's hearing is either better or worse than at the original examination.

What is obtained from the testing? A diagnosis? Rarely. We essentially determine whether a patient's hearing varies or not. That demonstration of variation is the all-important thing.

Having demonstrated a variation, it is the duty of the

otologist to make a continued search for factors which reasonably might cause that variation.

Lurie[1] emphasizes the irreversibility of the pathological changes which occur in the two main types of deafness, but I want to point out that he says nothing about the recoveries otologists know to occur frequently in lesions of the conductive apparatus and. also, that he has proved what was hitherto unproven, that complete recovery can occur in certain lesions of the perceptive apparatus.

If such is the case in adults, how much more is it the case in children with their great potentialities for recovery?

The examiner — aware of the difficulties of performing these tests in a manner which warrants comparison — cannot entrust these to a technician. He must do them himself. He must repeat them over and over.

The criticism will be made that this is ideal and not practical. It will also be said that such examination is a labor of love. Well, it is exactly that.

An Example Typical of the Work Involved.

The following illustrated case report is an example of the work required.

The patient is a virile, mentally keen boy who has had many hearing tests over a period of three years.

Four nearly identical 2A tests indicate that the lesion in his perceptive apparatus has remained unchanged (see Fig. 3).

Four 4A tests (see Fig. 4) indicate that a marked improvement in his hearing for speech occurred in the first few months of treatment, and has remained; but that patient still has a variation factor in his conductive apparatus for which a solution has not been found. He will come to the office full of assurance and yet make many errors (indicated in A) (see Fig. 5). After a short interval he can be retested and will make not the identical but approximately the same number of errors (indicated in B). Invariably, however, if his tubes are inflated he will hear accurately (indicated in C).

Improvements in Hearing.

At the Hospital for Sick Children we have been testing and treating deaf children for some years. The audiometric paterns of these children can be grouped according to Guild's

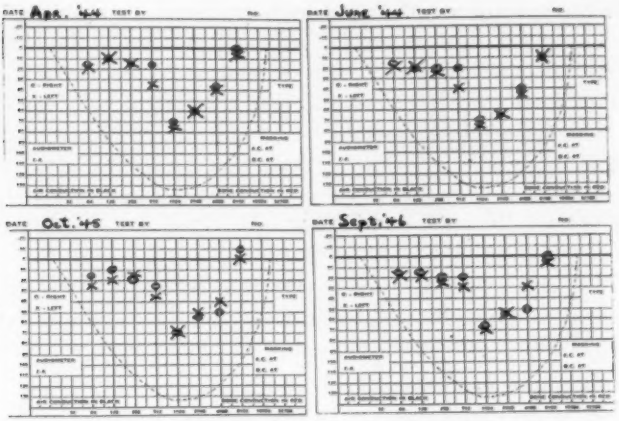

Fig. 3.

classification[10] into six categories. We have found this grouping useful. Subsequent to our efforts, a number of children have been found improved. (Note that I do not say *because* of our efforts.) The successes have nearly all been with Classes A and B. We have had some improvement with patients of Classes C and E but these have been very few. We have had no successes with Class F.

I want to subscribe heartily to Dr. Crowe's plea[9] for adequate attention to the nasopharyngeal lymphoid tissue.

Improvements in Hearing Which Followed Attention to the Nasopharynx.

The removal of T. and A. frequently has been followed by great improvement.

In some cases T. and A. has been performed and yet the nasopharyngoscope has shown that the adenoidectomy has been poorly done. Secondary adenoidectomy very often has been followed by improvement.

In other instances the T. and A. may have been well performed and the patient may continue to suffer from repeated colds.

Fig. 4.

In a number of such patients (see Fig. 6) who had small amounts of lymphoid tissue in the lateral pharyngeal recess or in the Eustachian cushion—amounts that were considered too small for secondary adenoidectomy — treatments with radon have been followed by spectacular improvement.

While it is probable that the lesion in this case was in the conductive apparatus, it is possible that the perceptive mechanism was at fault.

The graph of this patient proves that this degree of pure tone deafness does not justify a pessimistic prognosis.

From the above paragraphs it is not to be inferred that any cure is conjectured for what we consider incurable deaf-

Fig. 5.

ness in the young. I do, however, suggest that the percentage of improvements, which may follow careful measurements and persistent conscientious effort, will surprise the pessimists.

Spontaneous Improvement.

It is necessary to insert a word of caution. Improvement in hearing can occur in the absence of any form of treatment.

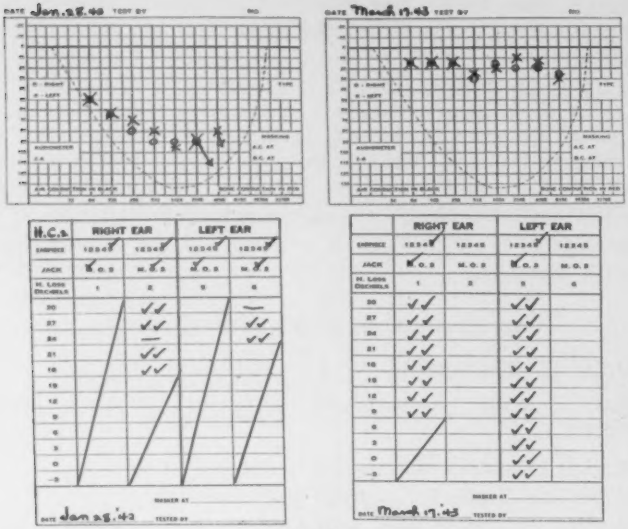
DATE Jan. 28. 42
DATE March 17. 43
H.C.S.
RIGHT EAR
LEFT EAR
Jan 28. '42
March 17. '43

Fig. 6.

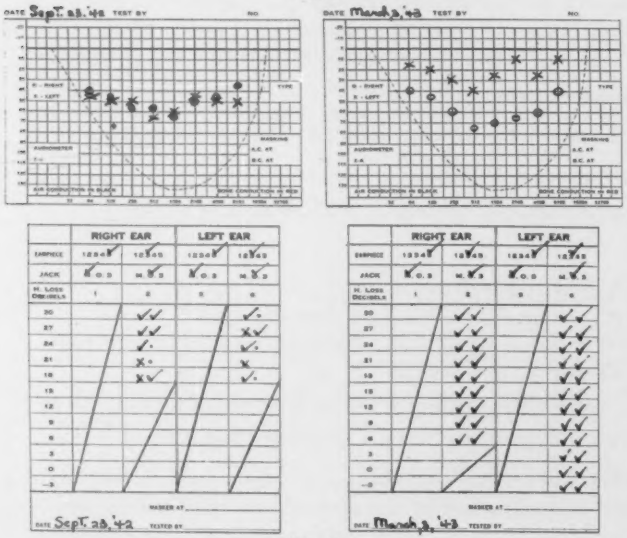
DATE Sept. 28. '42
DATE March 3, '43
RIGHT EAR
LEFT EAR
Sept. 28. '42
March 3, '43

Fig. 7.

An example of this is shown in Fig. 7. *Post hoc* is not always *propter hoc.*

Serous Otitis Media.

Serous otitis media is much more common in children than I formerly thought. Usually they are referred with a diagnosis of progressive perceptive deafness. Often the true diagnosis is not determined until demonstrated by inflation. The treatment of these children is arduous, but the improvement is most satisfying.

AN EXAMPLE OF IMPROPER PROGNOSIS.

CLINICAL RECORD.

Boy, 7½ years. Referred by neurological clinic — speech defective.

Mother considers his hearing defective.
Repeating Grade I. . . . Good with tools.
Healthy — quiet — good tempered.
E., N., T. — negative. T. and A. — removed.
Hearing — 2A — good — normal — 15 db. level.
4A — good enough — 20 to 24 db. level.

Otological Opinion.

Hearing within normal limits. R — psychometric tests.

Psychometric Opinion.

Speech defect will clear with proper training.

CRITICISM.

2A — perception excellent.
4A — shows real defect in hearing speech.
Incompletely examined. Nasopharyngoscope not used.
Hearing is not normal.
The defective hearing possibly the cause of defective speech.

Argument Against Using a Trained Technician.

This work I am advocating for hearing-deficient children should be performed by the otologist or by a science graduate. In my opinion it cannot be entrusted to a trained technician.

Our methods still are full of error hazards. A technician can be trained to identical technique and may be given unvarying conditions in which to work but he cannot have the third requisite — an understanding of his patient — until he has become experienced in otology. Almost in spite of every effort annoying errors will creep in, and the otologist who relies on the technician, if he is truly critical of his findings, will soon want to discard the technician. The otologist will realize he might better do the work himself.

Conclusion.

Hopeless prognosis for the little hard-of-hearing child must never be given unless the examiner has the ability to examine, has the proper apparatus and environment for testing the hearing, has the ability to apply the indicated therapy and — finally — has the patience and fortitude to do these things himself.

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Note: In discussing this paper, Douglas Macfarlan demonstrated an original method of measuring the hearing for speech. He puts the unamplified phonograph speech through a frequency audiometer via the loudspeaker plug. In this way he attains both the amplification and the metering required.

PENICILLIN THERAPY IN CHRONIC SUPPURATIVE SINUSITIS. A REPORT OF 22 CASES.*

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This study is concerned with the use of penicillin in the treatment of 22 cases of chronic suppurative disease of one or more paranasal sinuses. The problem was undertaken to prove or disprove the value of penicillin in these cases with a definite understanding of the numerous difficulties to be encountered. Few favorable reports have been made of improvement of chronic sinusitis by the use of penicillin therapy alone. It will be shown by both subjective and objective findings that cases of this type do yield to the clinical use of penicillin.

A REVIEW OF THE LITERATURE.

From late 1942 until the present time, numerous reports have been made concerning the treatment of sinusitis by penicillin. The method of treatment has varied. Among other procedures, penicillin solutions have been used for local instillation following antral lavage, continuous irrigations with the cannula *in situ*, sprays in the form of penicillin aerosol, and for displacement treatments. At present, there is little doubt that penicillin has a beneficial effect in the treatment of most acute ear, nose and throat infections. Numerous favorable reports have been made concerning penicillin used in acute and chronic mastoiditis, cavernous sinus thrombosis, lateral sinus thrombosis, acute pharyngitis, acute cellulitis, cervical abscess and Ludwig's angina. More than one case of acute pansinusitis with orbital cellulitis has been cured without surgical intervention, by penicillin alone. Considerable emphasis has been placed upon the importance of penicillin used pre- and postoperatively in cases of chronic sinusitis.

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Crowe[1,2] and his co-workers were among the first in this country to use penicillin locally in sinusitis. They reported two cases of chronic suppurative sinusitis in children treated in 1942. The first, a child with sinusitis of four years' standing, was treated both by antral irrigations instillations of crude penicillin and displacements with crude penicillin extract. A clinical cure was obtained after five months of such treatment, and there was no recurrence of symptoms during the following winter. The culture from this case showed hemophilus influenzae, pneumococcus and staphylococcus aureus. The second case, a younger child, was treated three times a week for three months by displacements with penicillin extract. The culture from this case showed hemophilus influenzae and pneumococcus. A clinical cure was accomplished. Crowe and his associates state that penicillin used locally has marked power of tissue penetration;[2] however, in acute sinusitis, where the organisms are close to the surface, local penicillin is more adequate than in chronic sinusitis where the organisms may be buried deep in the mucous membrane.[3]

Sale and Diamond[4] reported a case of suppurative sinusitis of seven years' duration in a 31-year-old soldier treated by local penicillin. Spinal puncture needles were introduced into the antra and left in place for 24 hours. Five cc. of penicillin solution containing 1,000 units per cc. were introduced every three hours for eight doses. A submucous resection was done, and 19 days later a second 24-hour penicillin treatment was carried out, resulting in a clinical cure. The follow-up on this case was only 15 days.

Fowlkes[5] reported the use of penicillin before and after surgery for chronic suppurative sinusitis. One case presented had bilateral, chronic maxillary sinusitis. Twenty thousand units of penicillin were given every three hours for the 24 hours preceding surgery and the same dose was continued for 10 days postoperatively. This patient's postoperative course was uneventful and there was a rapid clearing of nasal secretion. A second case with unilateral pansinusitis was treated with 20,000 units of penicillin every three hours for

three days prior to surgery. A Caldwell-Luc and transantral ethmoidectomy was performed. Penicillin therapy was continued for five days postoperatively and there was practically no nasal secretion following the removal of the packing.

Putney[6] reported one case of chronic maxillary sinusitis treated with instillation of a penicillin solution containing 250 units per cc. The cultures became negative, but the purulent discharge persisted.

Struble[7] states that in early acute sinusitis before an empyema has developed, local and intramuscular use of penicillin exerts a "favorable effect," although no more so than adequate conservative measures combined with the use of sulfonamides. He further states that in "subacute and chronic empyema of the maxillary and frontal sinuses and in chronic empyema of the ethmoid and sphenoid sinuses, local penicillin therapy shows great promise." He reports one case of severe, chronic, bilateral, suppurative maxillary and frontal sinusitis of seven years' duration. This case had been treated previously by numerous washings of the maxillary sinuses without improvement. Obstructing polypi were removed from both nasofrontal duct regions. Cultures revealed Type 17 pneumococcus. The patient was given 100,000 units of penicillin by intravenous drip, followed by 100,000 units intramuscularly, in eight divided doses for two consecutive days. There was no improvement in the patient's symptoms and the cultures remained positive. Penicillin solution containing 1,000 units per cc. was then instilled following lavage of the antra. Two days later, both antra washed clear and cultures revealed a few colonies of nonhemolytic staphylococcus. The left frontal was treated similarly with clearing following the treatment. The patient then developed infectious mononucleosis, but 18 days later the treated sinuses were still clear. About one and one-half months later, the right frontal sinus was treated as the others with a resultant clearing. The patient remained clinically clear after one month's observation. He concludes that parenteral penicillin used for two days did not effect a cure, but prompt improvement occurred after the local use of penicillin.

Priest[8] reported a series of eight cases of chronic sinusitis treated by local and parenteral penicillin. Four cases were further complicated by bronchiectasis. A total of 10 maxillary sinuses and two frontal sinuses were treated by repeated penicillin irrigations. Indwelling urethral catheters were placed in the affected sinuses and 4 cc. of a solution containing 8,000 units of penicillin per cc. were instilled every four hours. Parenteral injections of 20,000 units were given every four hours for 12 days. Of the 10 maxillary sinuses treated, four were improved, two of which cases were complicated by bronchiectasis. All those in the other bronchiectatic group required additional surgery of the sinuses before permanent improvement occurred. Two other maxillary sinuses which did not improve were subacute sinus infections. Priest abandoned this treatment routine as unsuccessful. Penicillin sensitivity tests were not done and cases with mixed infections were treated if at least one organism in the culture was considered to be sensitive.

Hauser and Work[9] treated 46 cases of infection about the nose and sinuses with penicillin. Eleven of these were treated by penicillin instillations after irrigation of the antra, and the remaining 35 were treated by penicillin alone, or in conjunction with radical surgery. They concluded that in subacute and early sinusitis, the local use of penicillin following lavage gave uniformly good results. They did not, however, treat any cases of long-standing chronic sinusitis with penicillin alone where it was felt that other generally accepted surgical principles of treatment would be beneficial; nevertheless, they report three cases of allergic rhinitis with superimposed sinus infection where cessation of suppuration occurred in one case and at least temporary improvement in the other two. In each of these cases the cultured organism was sensitive to penicillin. One other case of suppurative sinusitis of 17 weeks' duration was cured by parenteral penicillin alone. Another case of chronic suppurative pansinusitis with localized osteomyelitis in the left side of the frontal bone was cured by penicillin injections. They also report three

cases of chronic suppurative sinusitis of over two months' duration cured by reconstructive nasal surgery and penicillin given intramuscularly. These observers point out the possibility of intracranial complications in sinus disease even while penicillin is given in adequate amounts over long periods of time, and cite three cases to substantiate this warning.

Bloomfield[10] reported a case of chronic sinusitis of four years' duration in which the offending organism was staphylococcus aureus where osteomyelitis of the right maxilla developed. The case was treated with intramuscular penicillin over a period of one month. Following a sequestrectomy of the maxilla, the patient recovered.

Woodward and Holt,[11] in a study of the local use of penicillin in infections of the ear, nose and throat, conclude that it is of negligible value in chronic sinusitis alone, or in chronic sinusitis associated with allergic rhinitis.

Crowe and others[3] emphasize that mere identification of the organism alone is not sufficient basis for the clinical use of penicillin. This is especially true if one is dealing with a staphylococcal infection. Of 90 strains of staphylococcus tested by Fisher,[3] 12 were found resistant to penicillin. Some observers have found strains of staphylococcus to develop resistance to penicillin during the course of treatment.

It is generally accepted by all that in treating infections with penicillin, the organism should be identified if possible, and penicillin sensitivity tests should be accomplished. Both aerobic and anaerobic cultures should be made. Results cannot be expected from penicillin if the organism is not sensitive to it.

The concentration of penicillin solutions applied to the mucous membrane of the nose has varied in different hands from solutions containing 250 units per cc. to solutions containing 5,000 units per cc. Proetz[12] reports that weaker solutions of penicillin have no damaging effect on the cilia or epithelium, and in addition that solutions of higher concentration tend to increase ciliary action.

TREATMENT USED IN THE CASES PRESENTED.

The group of cases presented in this study includes all cases of chronic suppurative sinusitis that were admitted to an Army General Hospital in the United States from October, 1944, until February, 1946. Patients with acute suppurative sinusitis or subacute suppurative sinusitis have purposely been omitted. In these latter cases, there seems to be no question that sound conservative measures combined with chemotherapy or penicillin, or both, are the treatments of choice. For the same reason, reports of acute sinusitis with osteomyelitis or orbital cellulitis have been omitted. The purpose of this study was to evaluate the use of penicillin therapy alone in the treatment of chronic suppurative sinusitis. Since the majority of patients had been given previous treatment, including surgery in some, the possibility of improvement by conservative treatment seemed questionable.

In general, all cases were handled as follows: A careful history was obtained to ascertain if signs and symptoms indicated chronic sinusitis. A careful clinical examination of the ears, nose and throat was carried out and recorded. Chronic sinus empyema of one or more paranasal sinuses was confirmed in each case. All cultures were taken by the removal of actual pus from the affected sinus by means of a cannula and sterile syringe. The majority of cases had involvement of one or more of the maxillary sinuses, and a straight spinal needle was used for this purpose, being introduced through the inferior meatus. The specimens taken were sent immediately to the laboratory for culture studies.

Each case was seen in the ear, nose and throat clinic every two days. When necessary, the nasal mucosa was shrunk down by topical application of 2 per cent cocaine hydrochloride and by 0.25 per cent neosynephrine hydrochloride used in the form of a spray or on intranasal packs. Free pus in the nasal cavity was then removed by gentle tip suction. The affected maxillary sinuses were then lavaged with physiological normal saline until the return flow was clear. For this latter procedure a No. 17 straight spinal needle was used,

being introduced into the antrum through the inferior meatus. With the needle still in place, penicillin solution containing 250 units per cc. was instilled until there was a copious return flow from the nose. Careful notes were taken at each treatment concerning the character and amount of the pus, the general appearance of the nasal mucosa and subjective changes in the patient. The amount of pus was recorded as ranging from one plus, meaning a trace, to four plus, indicating approximately 6 to 8 cc. This local treatment routine was carried out upon each visit until the return flow was clear on washing the sinus, and until there was no sign of purulent discharge in the nasal cavity. At the same time, the patient was given intramuscular injections of penicillin — 20,000 units every four hours for six doses daily. As a rule, sinus irrigations were discontinued after the second negative lavage, but systemic penicillin was continued for a longer period, usually until it had been given for 14 days. When the nasal mucosa did not resume a normal appearance, penicillin was continued intramuscularly for a longer period. At the time when all penicillin was discontinued, sterile physiological saline was instilled into the sinus and after five minutes a sample was withdrawn and sent to the laboratory for final culture studies.

In the majority of cases, the initial purulent return from the affected sinus was broken-down, mealy, foul-smelling pus. It was found during the course of treatment that as soon as the pus became clumped or stringy in character, there usually occurred an abrupt improvement in both the appearance of the nasal mucosa and in the subjective complaints of the patient. After this clumping occurred, it was usually a rather short time until the return from the washing was clear.

An initial X-ray examination was made of the paranasal sinuses just prior to the beginning of treatment. In a few cases additional X-rays were available that had been taken several months previous to penicillin therapy. Follow-up X-rays were made irregularly at first, but later, as soon as the sinuses were clinically clear, and at least once again before the patient was discharged.

As each patient was followed clinically, transillumination of the sinuses was carried out and found to be of considerable value in following clinical improvement. In most cases there was a marked improvement in transillumination and in several cases transillumination was clear after treatment was stopped while X-ray examination did not show any appreciable improvement.

When the patient was clinically symptom-free, he was usually sent on a 30-day convalescent furlough. Upon return from furlough, a careful interim history was obtained and a further clinical study was done and recorded. Samples were taken with sterile, normal, physiological saline as described above and sent to the laboratory for culture.

It is evident that such a scheme of treatment as outlined above is bound to be tedious both to the patient and to the doctor; nevertheless, the cooperation of the patients in this series was excellent. The majority of them were ambulatory and could keep busy at various nonstrenuous activities between penicillin injections and visits to the nose and throat clinic.

In the laboratory, specimens were immediately inoculated into glucose brain broth and incubated for 24 hours. The organisms were then isolated on blood agar plates. When isolated and identified, penicillin sensitivity tests were done. Difficulty arose in carrying out anaerobic culture studies because of the lack of proper media and equipment for this purpose. An attempt to isolate anaerobic organisms was made by covering the glucose brain broth with a layer of paraffin. Since this method is grossly inadequate for this purpose, many anaerobic organisms were undoubtedly never found. Consequently, a few negative cultures were reported in the face of positive evidence of pus and bacteria, but not until after 10 days of incubation.

Although intensive local therapy other than that mentioned above was not used in the cases reported, sound surgical principles of drainage were not neglected. In two cases it was necessary to augment drainage by indicated surgery;

namely, a submucous resection in one case, and the removal of a nasal polyp in another. Infraction of the middle turbinate was done routinely in all cases where there was questionable drainage due to edema and swelling in the middle meatus. Response to treatment is shown in the following case report:

Case 1: Male, white, age 24 years.

History and Diagnosis: Patient had influenza in December, 1943, at which time severe left frontal and cheek pain with purulent nasal discharge developed. Left antrum was washed 14 times with some temporary improvement. Intermittent attacks with severe frontal headaches with copious purulent discharge up to the present time. Developed acute upper respiratory infection. August, 1944: Right antrum washed several times. Headaches continued bilaterally, aggravated by flying. Recurrent right otitis media since childhood. Present sinus history dates back nine months. Diagnosis: Pansinusitis, chronic, suppurative, bilateral, severe.

Clinical Findings and Course: Oct. 13, 1944: Routine physical and history negative. Throat: tonsils are out. Small amount of lymphoid tissue in the nasopharynx. Copious purulent, sticky discharge throughout the pharynx. Nose: both nares have wet, boggy mucosa. Thick, yellow pus in both middle meati and on the floor of the nose. Larynx normal. Right tympanic membrane is retracted and scarred. Hearing is normal. L. A., ++++, broken-down. R. A., +++, broken down. Oct. 19, 1944: L. A., +. R. A., +++, broken-down. Oct. 21, 1944: L. A., ++. R. A., +. Oct. 23, 1944: R. A. and L. A., +++, broken-down, foul. Oct. 25, 1944: R. A., +. L. A., +++. Oct. 27, 1944: Severe frontal headache. Appearance of the nose is unchanged. Considered bilateral, radical antrum. Nov. 5, 1944: L. A. and R. A., +++, foul. Penicillin regimé begun. Nov. 6. 1944: R. A. and L. A., +++, clumped. Nov. 8, 1944: R. A. and L. A., ++, clumped. Nov. 10, 1944: Nose looks much improved. No pus or edema of the mucosa. Headaches have stopped. L. A. and R. A., trace. Nov. 13, 1944: L. A. and R. A., trace. Nov. 18, 1944: L. A. and R. A., clear. Nose normal in appearance. No headaches. Nov. 24, 1944: Penicillin stopped. Jan. 4, 1945: No complaints. Nose clinically normal. R. A. and L. A., clear.

Cultures: Oct. 13, 1944: Staphylococcus albus. Nonhemolytic. Oct. 23, 1944: Staphylococcus albus. Hemolytic. Oct. 27, 1944: Staphylococcus albus. Hemolytic. Nov. 10, 1944: Negative. Nov. 18, 1944: Negative. Jan. 4, 1945: No growth.

Penicillin Sensitivity: Oct. 13, 1944: 0.04 units per cc. Oct. 23, 1944: 0.08 units per cc. Oct. 27, 1944: 0.04 units per cc.

Transillumination: Oct. 13, 1944: All sinuses are dark. Oct. 23, 1944: All sinuses are dark. Oct. 27, 1944: All sinuses are dark. Nov. 18, 1944: R. A. and L. A., clear. Nov. 24, 1944: Frontals slightly cloudy. Jan. 4, 1945: Sinuses clear.

X-rays: Oct. 14, 1944: Diffuse clouding of all sinuses. Nov. 21, 1944: Frontals still cloudy. Antra still cloudy. Dec. 6, 1944: Frontals clear. Antra clear except for small area thickened mucosa on floor of left. Jan. 6, 1945: All sinuses clear.

Total Penicillin Used, Period of Observation After Treatment and Result: 2,380,000 units penicillin used. Period of observation after treatment, 44 days. Result: Clinical cure of chronic pansinusitis of nine

months' duration. Trial period of antral lavage and conservative therapy did not alleviate symptoms or decrease the purulent drainage. Prompt response to penicillin therapy. X-ray evidence of clearing of all sinuses.

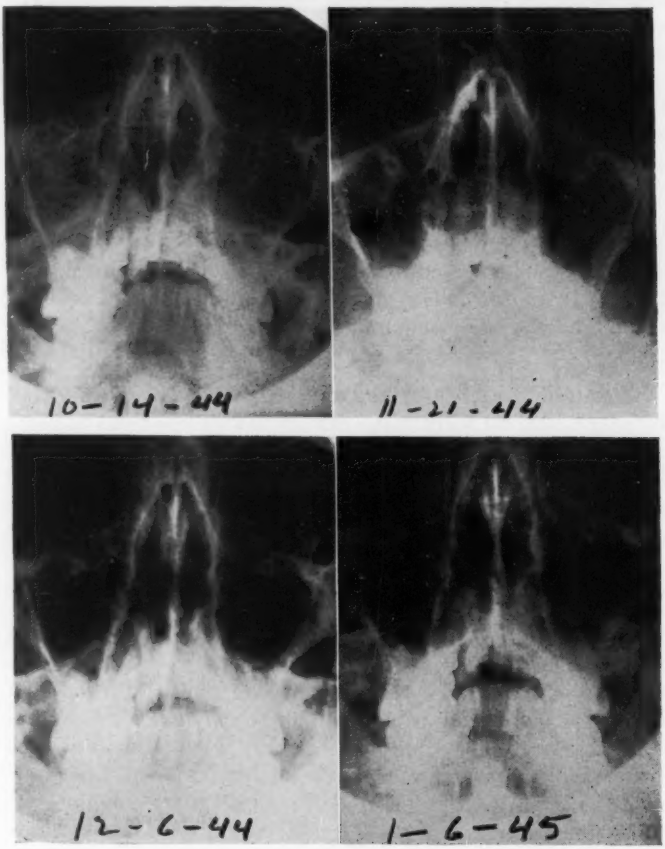

Fig. 1.

This group of cases is made up for the most part of young adults with chronic sinusitis. The average age of the patients treated was 27.5 years. Each was incapacitated for further

useful service in the Army because of chronic, suppurative sinusitis. The duration of symptoms varied from eight weeks to approximately 10 years. Seven cases were treated by nasal shrinkage, tip suction, washing of maxillary antra with physiological normal saline, combined with bed rest and general supportive treatment, prior to penicillin therapy. The first case treated, although of only eight weeks' duration at the beginning of treatment, became a case of five months' standing before penicillin therapy was begun. Case 16 was similar, being treated for 71 days prior to penicillin therapy. In each of these seven cases there was no improvement with the treatment measures outlined above prior to penicillin therapy. All of these cases in this study were treated conscientiously by the "penicillin regimé" previously outlined. The average length of follow-up after penicillin therapy was 52.6 days. The average amount of penicillin used was 2,100,000 units.

Sixteen of the 22 cases had pansinusitis. Of these, six were unilateral and 10 were bilateral. In six of the total number, one or both maxillary sinuses alone were involved. Four of this group had bilateral involvement, and two, unilateral. The remaining two cases had bilateral maxillary involvement and extreme frontal sinus involvement as well. X-ray studies here revealed a definite osteitis and a very likely osteomyelitis of the frontal bone (see Table 1).

Although all of these cases had received some previous treatment for sinusitis, four of them had been subjected in addition to some form of previous intranasal surgery. In Case 10, a bilateral, intranasal antrotomy was done three months prior to the time of treatment with penicillin. Following the operation, there was no improvement in symptoms. This patient had a probable nasal allergy, which will be discussed later. In Case 11, a left Caldwell-Luc operation was done six months before the penicillin treatment was given. Following surgery, the patient complained of more headache and nasal discharge than previously. This patient had in addition to chronic suppurative sinusitis of long standing, a mild but definite cylindrical bronchiectasis. In Case 12,

bilateral intranasal antrotomies and a left anterior ethmoidectomy had been performed eight months before the present hospital admission. Although he was given 1,000,000 units of penicillin postoperatively, there was no improvement in headaches and nasal discharge. Case 19 had a polypectomy and the removal of the anterior tip of his right middle turbinate about one year before his penicillin treatment. Follow-

TABLE 1. TYPES OF CASES TREATED.

Pansinusitis		Maxillary Sinusitis		Frontal Sinusitis
Unilateral	Bilateral	Unilateral	Bilateral	with Osteomyelitis
Case 3	Case 1	Case 9	Case 2	Case 12
6	5	14	4	20
7	10		8	
12	11		15	
16	13			
20	17			
	18			
	19			
	21			
	22			
Total Cases 6	10	2	4	2

ing this surgery, headaches stopped for a short time only, and purulent nasal discharge continued in spite of many antral irrigations.

Although the surgery done in these cases was performed by a competent otolaryngologist, it did not bring about a clinical improvement in the patient. It is impossible to say whether or not penicillin therapy prior to, or at the time of surgery, would have brought about a cure. It is likely that a combination of penicillin before and after surgery would have been beneficial.

Although the clinical results from penicillin therapy in the present group of cases was almost uniformly good, no attempt is made to disregard the importance of good, sound surgical principles of treatment established in the past. Six of the 22 cases required some form of surgery before they remained

clinically well. In one case a bilateral Caldwell-Luc was performed before penicillin was used. It is impossible to say whether this operative procedure would have been necessary had this case first been treated with penicillin. At operation, both maxillary sinuses were found to contain free pus and an irregularly thickened mucous membrane. There were no localized cysts or abscesses. In Case 4, an oroantral fistula had developed following a tooth extraction in a patient who already had bilateral, chronic suppurative sinusitis. With penicillin treatment the patient improved clinically and the maxillary sinuses became free of pus before the plastic closure of the fistula was done. Because of the previous history of sinusitis in this case, it was deemed advisable to do a Caldwell-Luc in addition to closure of the fistula. The mucosa of the maxillary sinus was found to be thickened and there was a large amount of granulation tissue on the floor of the sinus about the fistula. Case 9, another case of oroantral fistula of three years' duration, had no further sinus involvement other than the maxillary with the fistula. On penicillin therapy the affected maxillary sinus became free of pus, the patient symptom-free and X-ray improvement was evident. The overall improvement was so profound that closure of the fistula without any additional sinus surgery was considered the best procedure. Although the patient developed a flare-up postoperatively in the left maxillary sinus following swimming, the fistula remained closed and he was symptom-free when discharged from the hospital. Case 7 presented right suppurative sinusitis with a marked septal deviation to that side. It was impossible to infract the right middle turbinate. To promote drainage from the right middle meatus, a submucous resection was done during the time the patient was receiving penicillin. Case 17, one of chronic suppurative sinusitis of 10 months' duration, had been treated by numerous antral lavages followed by instillation of penicillin. There was no improvement of symptoms with this treatment. With penicillin therapy as outlined in this series of cases, marked clinical improvement ensued. The right antrum remained free of pus, but the left flared up and the patient's nasal discharge and symptoms returned after peni-

cillin was discontinued. A left Caldwell-Luc operation was performed and the final result was very satisfactory. It is interesting to observe that at operation, a large, thick-walled multilocular cyst filled with pus was found attached to the superior wall of the maxillary sinus. In washing the antrum through the inferior meatus, only the cavity below the cyst was being treated. Reinfection from the disease process above was a simple matter. Undoubtedly penicillin therapy alone could never have been of great benefit in such a case. Case 21, a bilateral suppurative sinusitis of long standing, improved markedly with penicillin therapy, but a small polyp in the left middle meatus failed to resolve. Although the sinuses were free of pus and the patient was symptom-free, the polyp was removed to insure more adequate drainage from the middle meatus. In both Case 12 and Case 20, X-ray evidence of osteitis and probable osteomyelitis was found. In both cases surgery was refused by the patient. For this reason, penicillin therapy was begun with very little hope of improvement. Both cases became clinically free of headache and discharge and there was questionable improvement by X-ray. It is doubtful that either case will remain well in the face of subsequent acute upper respiratory infections. Case 12, however, was well four months after treatment.

In nine of the 22 cases presented, the mucous membrane about the middle meatus showed a definite polypoid and hyperplastic appearance. In eight of these cases following penicillin therapy, there was complete resolution of the polypoid tissue without surgery of any type. In one patient, Case 21, marked improvement occurred and in place of extreme polypoid and edematous tissue in the middle meatus, there remained one solitary pedunculated polyp. It is evident, therefore, that if drainage is adequate and response to penicillin therapy is prompt, it is better to postpone surgical interference with polypoid tissue until the completion of the penicillin treatment.

Four of the 22 cases showed some allergic manifestations. In Case 8, a definite allergic history was not found. The nasal mucosa appeared wet, bluish and boggy as so often

occurs in allergic rhinitis. Positive eosinophile smears were never found and nothing more than one plus reactions were obtained in allergy skin tests. This patient had a profound objective clinical improvement both by transillumination and sinus X-ray, but complained of headaches at the completion of treatment. Case 10, following penicillin treatment, had positive eosinophile smears and a definitely allergic mucosa. He obtained marked clinical improvement in his sinus condition. Case 16 had a history of perennial allergic rhinitis and was sensitive to numerous allergens. The nasal mucosa appeared allergic following treatment, but eosinophile smears were negative. At the completion of treatment the patient was free of symptoms of sinusitis. Case 19 had no definite history of allergic rhinitis; however, he had had a polyp removed from the nose previously and after treatment the nasal mucosa appeared allergic. Skin tests and eosinophile smears were negative.

It is reasonable to assume that a nasal allergy was present in each of the above four cases. Suppuration and headaches stopped following penicillin therapy, but the nasal mucosa did not regain a normal appearance. In such cases it is very likely that an acute flare-up in the nasal allergy might precipitate further attacks of chronic suppurative sinusitis.

The bacteria found in this group of cases will be seen in Table 2. It is noted that those organisms which were isolated

TABLE 2.

Organisms Isolated	Found in Cases	Total Cases
Streptococcus hemolyticus	4, 6, 9, 17	4
Streptococcus viridans	1, 2, 10	3
Staphylococcus aureus hemolyticus	1, 8, 15	3
Staphylococcus aureus nonhemolyticus	3	1
Staphylococcus albus hemolyticus	13, 20, 21	3
Staphylococcus albus nonhemolyticus	5, 7, 9, 11, 12, 13, 22	7
Pneumococcus (not typed)	2	1
No growth	1, 14, 16, 18, 19	5

on culture were all Gram positive cocci. Pneumococcus was isolated in one case but died out on culture before it could be typed and was not found in subsequent culture. In five of

the 22 cases no growth was obtained. In one of this group of cases a Gram negative bacillus was identified on smears. In another of this group, a Gram negative bacillus and a Gram negative coccus were identified on smears, but failed to grow. It is unfortunate that anaerobic culture studies were not possible, for undoubtedly the offending organism in each of these cases was an absolute anaerobe. The treatment with penicillin in each of these cases was necessarily a matter of chance, but the clinical results justified its use.

CLINICAL RESULTS OF TREATMENT.

The clinical results of treatment in this group of cases are given in Table 3. It is noted that 19 of the 22 cases stated that they felt well at the end of their follow-up period, which speaks well for penicillin therapy. Three cases were not entirely well. One of these three had a definite nasal allergy and his only complaint was occasional sneezing. Another felt improved but complained of mild, persistent headaches. This patient was discharged from the Army for other reasons before a sufficient period of observation. The third unimproved case had persistent headaches and yet objectively he had profound improvement in his sinusitis. His headaches were attributed to a neuropsychiatric basis by the psychiatrist. One hesitates, however, to make this latter diagnosis in any patient who has just recovered clinically from chronic suppurative sinusitis.

Further analysis of the clinical results shows that suppuration from the nose and sinuses ceased entirely as far as could be determined clinically in 21 cases. The remaining case showed some slight crusting over an atrophic middle turbinate which was a result of previous surgery.

In five cases, nasal stuffiness persisted to some degree. Four of these were cases of proven or suspected allergy. The other case was entirely free of symptoms except for periodical nasal stuffiness.

The appearance of the nasal mucosa returned entirely to within normal limits except in five cases. Four of these were

TABLE 3. CLINICAL EVALUATION OF RESULTS.

Case	Suppuration	Headache	Nasal Stuffiness	Nasal Mucosa	Transillumination	X-ray Improvement	Patient's Statement
1	None	None	None	Normal	Clear	Moderate	Well
2	None	Mild	None	Normal	Clear	Slight	Improved
3	None	None	None	Normal	Clear	Moderate	Well
4	None	None	None	Normal	Partially Clear	Moderate	Well
5	None	None	None	Normal	Clear	Marked	Well
6	None	None	None	Normal	Clear	Marked	Well
7	None	None	None	Normal	Partially Clear	None	Well
8	None	Mild	Slight	Allergic	Clear	Marked	Headaches persist
9	None	None	None	Normal	Clear	Moderate	Well
10	None	None	Moderate	Allergic	Cloudy	Slight	Well except sneezing
11	None	None	None	Normal	Clear	Moderate	Well
12	Crusting	None	None	Mild Atrophy	Dark	Slight	Well
13	None	None	None	Normal	Clear	Marked	Well
14	None	None	None	Normal	Clear	Moderate	Well
15	None	None	None	Normal	Clear	Marked	Well
16	None	None	Slight	Allergic	Clear	Moderate	Well
17	None	None	Slight	Normal	Clear	Marked	Well
18	None	None	None	Normal	Cloudy	None	Well
19	None	None	Slight	Allergic	Clear	Moderate	Well
20	None	None	None	Normal	Cloudy	Slight	Well
21	None	None	None	Normal	Clear	Slight	Well
22	None	None	None	Normal	Clear	Marked	Well

the allergic rhinitis mentioned above and the fifth was the case previously mentioned with mild atrophy of the middle turbinate.

In general improvement in X-rays of the sinuses was considerably less than would be expected with the above favorable clinical results. A beginning air cavity in a sinus was considered as a basis for designated improvement by X-ray. This condition is indicated in Table 3 as "slight" improvement. When the air cavity had increased in successive X-rays but did not fill the entire sinus, it was considered "moderate" improvement. When the air cavity appeared to fill the entire sinus, the X-ray improvement was designated "marked." It is probable that a few cases at least, with little improvement in their X-rays, would have shown further clearing over a longer period of time.

It was found, however, that clinical improvement in the patient was usually accompanied by a corresponding improvement in transillumination, regardless of the X-ray appearance of the sinuses. When transillumination did not improve, any clinical improvement was only of a temporary nature.

SUMMARY AND CONCLUSIONS.

1. A resumé of the literature concerning treatment of chronic sinusitis with penicillin is given. Up to the present time, the results of treatment of chronic sinusitis with penicillin alone has been a question of uncertainty. Most observers agree that penicillin therapy is advantageous if used in conjunction with sinus surgery. Culture studies, isolation of the organism, and penicillin sensitivity tests *in vitro* are essential prior to treatment with penicillin. That the organism be sensitive to penicillin is essential.

2. A method used for penicillin treatment of cases of chronic suppurative sinusitis is outlined.

3. Tabulated case reports of 22 cases of chronic suppurative sinusitis are presented with X-ray photographs of the sinuses.

4. Penicillin therapy is not advocated as a general replacement for sinus surgery. Attention is drawn to cases having

surgery prior to penicillin therapy and to those cases requiring surgery in conjunction with penicillin therapy. Minor surgery to improve drainage is considered essential. Radical surgery should be undertaken only when necessary to maintain the improvement already accomplished by penicillin or when penicillin has failed to bring about clinical improvement. Two cases with probable osteomyelitis of the frontal bone, where surgery was refused, obtained clinical improvement with penicillin therapy alone.

5. In cases of allergic rhinitis with chronic suppurative sinusitis, improvement in the allergy itself is not obtained. Polypoid hyperplastic changes of the nasal mucosa in non-allergic cases react favorably to penicilllin therapy.

6. Penicillin therapy has a definite useful place in the treatment of chronic suppurative sinusitis as evidenced by the clinical results of the 22 cases reported in this study.

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CLOSURE OF PERFORATIONS OF THE TYMPANIC MEMBRANE.*†

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The treatment of perforations of the tympanic membrane was first directed toward the use of artificial membranes. In 1640, Marcus Banzer[1] proposed protecting the middle ear exposed by a perforation by placing in the auditory canal a tube of ivory covered over the end with a piece of pig's bladder. Yearsley[2] was apparently the first to use artificial drum membranes to improve hearing. As far back as 1841 he used pledgets of cotton wool applied to the perforation. In 1857, Toynbee[3] independently suggested the use of thin vulcanized rubber discs placed over the perforations to improve hearing. In 1878, Berthold[4] proposed myringoplasty as an operative method of closing perforations. He applied a small piece of adhesive plaster across the perforation, removed it in three days, and placed a small skin graft from the arm over the defect. Various authors have used paper, egg skin, wax, paraffin oil soaked into a cotton ball, cadaver stapes, Cargile's membrane and gold dental cylinders for artificial membranes. Roosa[5] and Politzer[6] were among the first to permanently close perforations by stimulating healing at the perforation margins. They used the silver nitrate stick to cauterize the margins of the perforations. Okuneff[7] first used trichloracetic acid cautery in 1895, which is the method with which we have had our experience. He stated that if the second or third treatments were not successful, one should abstain from further treatment. In 1917, Dunlap[8] reported from China on this method of closure and presented cases in which the method was successfully used. He pointed out that often a great many treatments are necessary to close a perforation. In 1919, Joynt[9] reported on four closures and one failure in

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using the method in conjunction with paper prosthesis. Griot,[10] in 1931, reported on three cases of successful drum closure and several failures by blowing hot air from a Politzer bag against the drum until it was quite red. In 1914, Linn[11] reported two closures using acid cautery, protonuclein dusting powder and euthymol drops. Fox[12] reported several dozen closures in 1945 using trichloracetic acid cautery to the margins and applying Cargile's membrane the next day.

The most recent works on artificial membranes were reported by Nasiell,[13] in 1934, and Steinmann,[14] in 1945, both of whom used cellophane. Both noted good hearing improvement in almost all cases and state that placing the prosthesis on the perforation causes growth of membrane and even closure in some cases. These prostheses have to be replaced after several weeks because of epithelial wandering, even though they are glued in place by a collodion mixture. Cellophane balls glued in the regions of the stapes in radical mastoid cavities has resulted in remarkable hearing improvement according to Steinmann; however, the technical problem of producing a prosthesis which will cause no pathological irritation and remain in place has not been solved. Myringoplasty was revived in 1944 by Shulhof and Valdez,[15] of Mexico, who reported success when using deep general anesthesia and measures directed toward preservation of the vitality of the skin graft.

Some definite benefits can be derived from the permanent closure of drum defects: *1.* There is often relief from repeated ear infections in those previously subject to them. It is very likely in these cases that the drum again acts as a barrier against invasions from without and as a deterrent to the easy passage of mucus and infected exudate from the nasopharynx upward through the Eustachian tube. Often individuals with a record of years of intermittent otorrhea following nasopharyngeal infections are completely freed from this annoyance following successful closure. *2.* In some cases there is an increase in auditory acuity and in interpretation of the source of sound. *3.* Closure of a drum defect is an aid to applicants for specialized military and civilian training schools

who previously could not meet the minimum physical qualifications. *4.* Occasionally a patient can be relieved of a troublesome tinnitus. *5.* After a drum has been repaired, patients who are enthusiasts of aquatic sports can return to the water without fear of otitis media.

As previously stated, the method is not new. It consists of repeated applications of a small amount of saturated solution of trichloracetic acid to the margin of a drum perforation. It is essential to touch this margin with a local anesthetic first as direct application of the acid can be extremely painful. A good anesthetic agent is made by grinding in a mortar equal amounts of menthol, phenol and cocaine crystals until a clear liquid is obtained. A small cotton-tipped applicator can be used to apply the anesthetic. The margin is wiped dry so that the acid will not be diluted or run onto adjacent drum membrane.

A small copper or silver wire bent into a loop at one end for a handle is dipped into the acid and carefully applied to the entire margin. As the acid touches the drum, a white eschar appears and one can see how completely the margin has been treated. Applications are made at weekly intervals until a good granulating margin has been obtained. This may require weeks or months. No patient or doctor should start unless both have unlimited patience.

If the perforation margin is slow in reacting, the use of two or three drops of saturated solution of urea once or twice daily will incite an inflammatory response, which in our experience has aided in closure.

Acid touching any part of the external canal or middle ear will cause considerable pain which lasts from two to three minutes. This incident is particularly undesirable in children, as they will not give their complete cooperation if treatments are painful. It is sometimes advisable to wrap a child in a sheet for accurate application of the acid.

Formation of an exudate along the margin is evidence that activity is present. Dried exudates are removed about twice a month because they cover the active drum margin and may

mechanically prevent closure. A small cerumen hook or hooked cautery wire serves ideally for removing these crusts (see Fig. 1).

In our experience closure is slow until the entire margin is active. Inactive segments are likely to occur when the operator has been timid in making a sufficient number of cauterizations. Any perforation which refuses to close should be searched for inactive segments and applications made at those points. Inactive segments of the margin fail to show a flare when touched with the cotton-tipped applicator. There comes

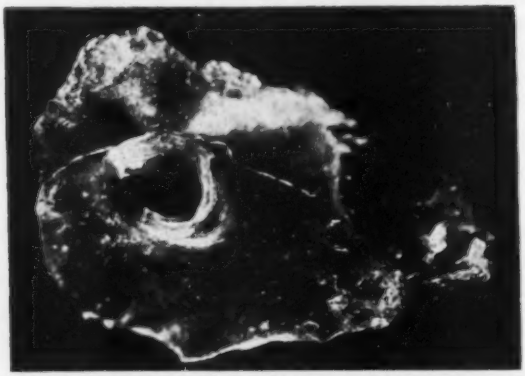

Fig. 1. Highly magnified dried exudate removed from the margin of a perforation of a tympanic membrane under treatment, showing the central curled collar which may act as a mechanical barrier to further closure.

a time, varying with each case, when the entire margin is active. At this point cautery should be less frequent, but urea drops should be used once or twice daily. Some patients complain of a moderate degree of irritation when the urea is first used. In this connection we have noted several large perforations which seemed resistant to treatment but which closed rapidly when an attack of otitis media caused an inflammatory reaction in the drum.

The procedure requires in the average case from six months to one year for closure, depending upon: *1.* Size of the per-

foration, *2*. occurrence of intervening attacks of otitis media, *3*. character of drum response, *4*. age of the patient, and *5*. the skill and perseverance of the operator. Some close in three weeks and others may require much longer than a year. The younger the patient the greater the chance for success; however, patients over 50 years of age have been successfully treated.

Contraindications to attempting closure are: *1*. Any form of mastoid diseases. *2*. Presence or suspicion of cholesteatoma of the middle ear. *3*. Destruction of the ossicular chain in some cases. *4*. Continuously discharging ear. Slight moisture on a normal appearing middle ear mucosa is a frequent finding and clears up as the perforation closes. Intermittent discharging ears are frequently closed by the method but a dry period must be secured. *5*. Complete loss of pars tensa, *6*. Large marginal perforations. Our experience has been that destruction of drum down to the annulus, if involving more than a very small area, will not close. *7*. Obstruction of the Eustachian tube.

The most suitable case for closure is one in which a dry perforation is present with a good periphery of drum. There is usually a moderate deafness, but not enough to imply destruction of the ossicular chain.

If the ossicular chain is intact, hearing is almost certain to be improved. A small paper splint or glycerine soaked cotton pledget applied so as to close the perforation will frequently demonstrate increased hearing and the probable result.

In our experience better auditory acuity and more relief from tinnitus has resulted from closing defects beneath the umbo.

HISTOPATHOLOGY.

The process of drum repair stops when the more hardy, rapidly growing stratified squamous epithelium of the external surface of the drum grows over the perforation edge and meets the pseudostratified columnar or cuboidal mucous membrane of the middle ear. Destruction of the perforation

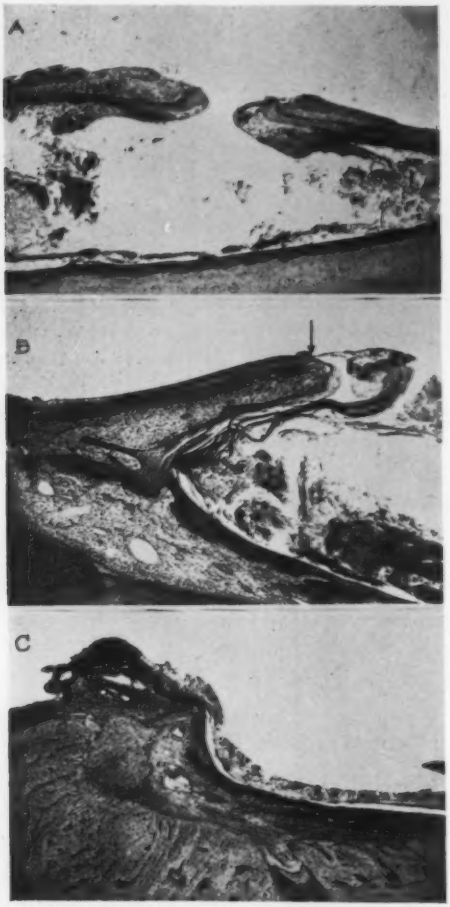

Fig. 2a. Horizontal section through a small dry perforation six days after myringotomy for an acute suppurative otitis media. The squamous epithelium seems hypertrophic at the margin and exhibits a tendency to grow inward.

Fig. 2b. Horizontal section through the margin of a large central perforation in the tympanic membrane due to chronic suppurative otitis media in a five-year-old female who died of acute lymphatic leucemia. The margin appears healed by an ingrowth of epidermis to meet the mucosal surface (arrow).

Fig. 2c. Horizontal section through a large defect in the tympanic membrane in a case of chronic suppurative otitis media with cholesteatoma. Death was due to meningitis. The section demonstrates the ingrowth of epidermis into the middle ear over the margin of the drum at the annulus. The difficulty in closing a marginal perforation is hereby illustrated.

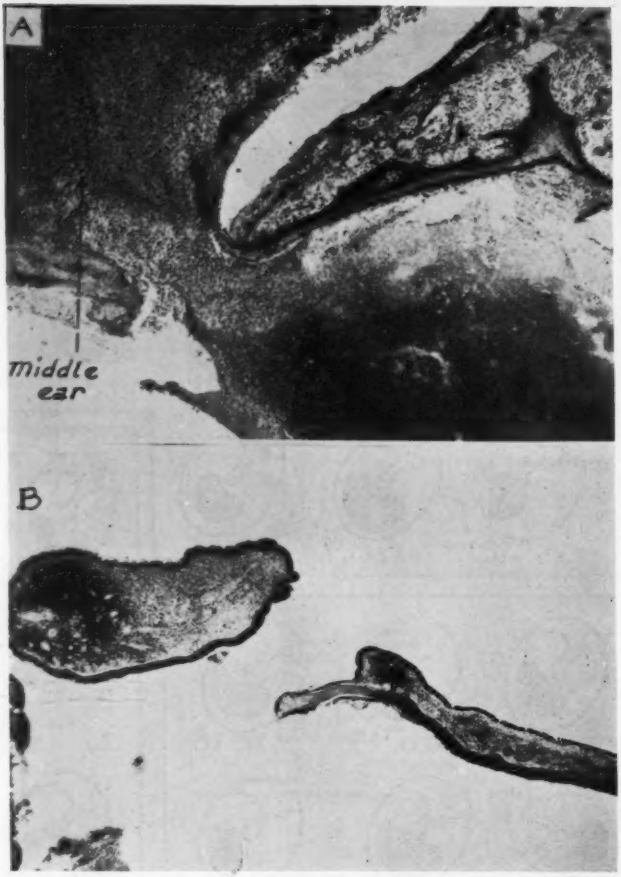

Fig. 3a. Perforation of the tympanic membrane in a case of acute suppurative otitis media. The epithelium of the mucosal surface of the drum has been destroyed by the inflammatory process. The epidermis shows a tendency to grow inward over the margins of the defect into the middle ear.

Fig. 3b. Horizontal section through a posterior marginal perforation in a 36-year old male. The epidermis at the annulus has been injured in preparation, but the epidermis has not progressed over the margin into the middle ear. The perforation is filled by a polypoid granulation covered by mucous membrane. This illustrates that ingrowth of epidermis into the middle ear does not occur in all marginal perforations.

margin with acid removes this epithelial barrier and incites by tissue destruction an inflammatory healing response in

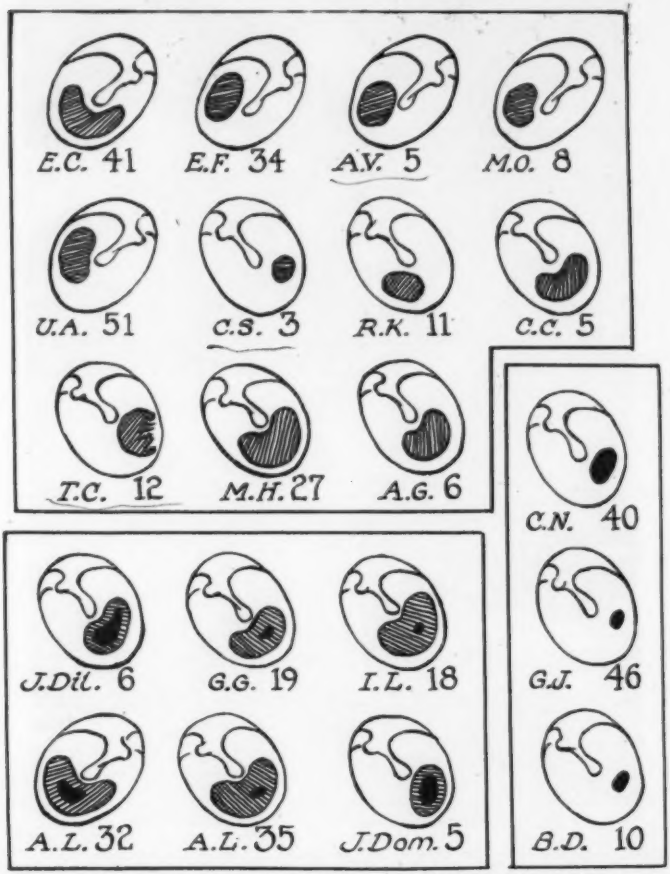

Fig. 4. Diagrammatic sketches are shown of 20 tympanic membrane perforations treated by the trichloracetic acid method. The upper 11 have been closed, the lower six are under treatment, and the three on the right failed to close. The number of treatments in each case is indicated.

the drum margin. Fibroblastic proliferation in the middle layer of the granulating margin is responsible for the laying

down of interlacing fibres of collagen. The epithelium grows over the perforation in four days to a week and must be repeatedly destroyed.

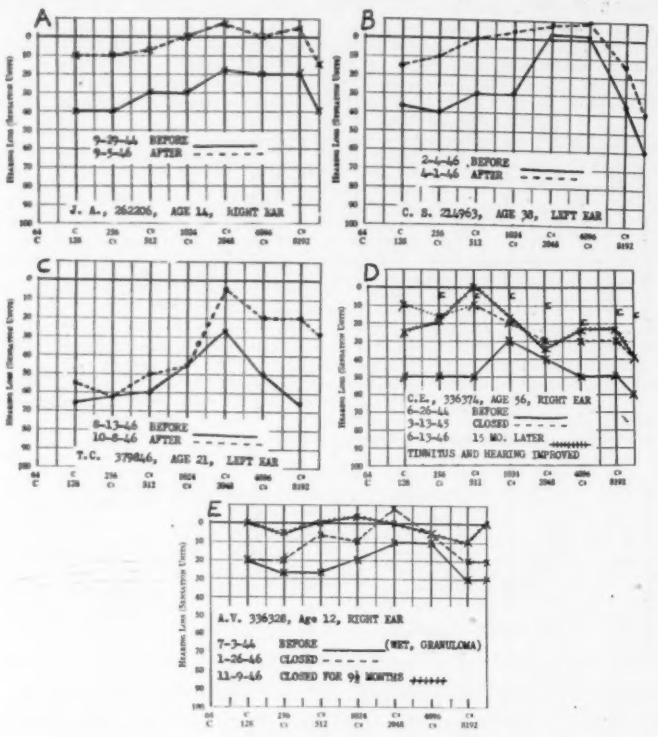

Fig. 5.

When collagen fibres are completely formed they shorten. The shrinking of this circular band of interwoven collagen fibres may facilitate closure by purse string action.

The regenerated drum so closely resembles normal drum that usually one cannot determine where normal drum ends

and regenerated drum begins. One rarely sees as a result of this method the thin atrophic segments often occurring after spontaneous closure (see Figs. 2 to 4).

A few representative case histories will be given. All audiograms shown, unless otherwise indicated, were taken when there was no clinical evidence of active middle ear disease.

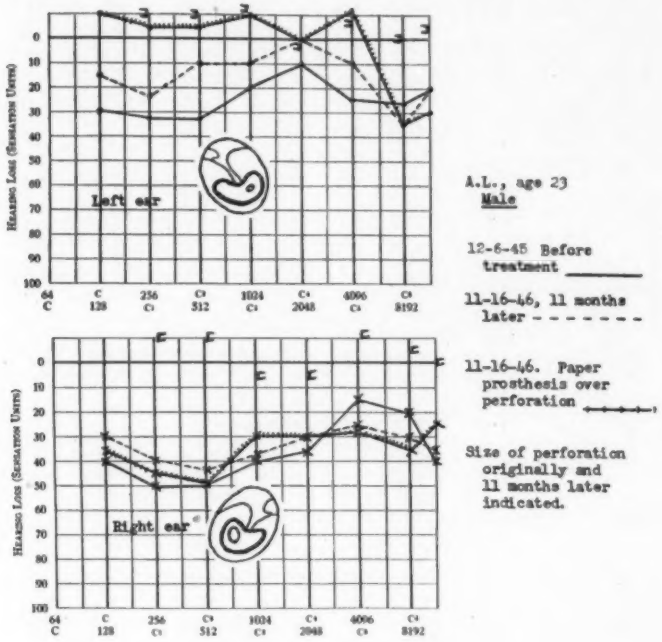

Fig. 6.

Case 1: J. A., a 14-year-old boy, had intermittent drainage from the right ear for the past three years. There was a large posterior perforation of the tympanic membrane. After the middle ear infection subsided, 51 treatments in 23 months were required for closure. There was good hearing improvement (see Fig. 5a).

Case 2: C. S., a 38-year-old man, developed pain and discharge from the left ear following a head cold. He had had a similar episode six

months previously. The infection subsided in four days. A small posterior perforation was closed by four treatments in two months (see Fig. 5b).

Case 3: T. C., a 21-year-old girl, had almost constant discharge from the left ear since childhood. There was a large posterior perforation which appeared to be marginal in a small segment. After becoming dry, 12 treatments in 12 months were required to close the perforation (see Fig. 5c).

Case 4: C. E., a 56-year-old woman, complained of tinnitus and deafness in the right ear of three years' duration. Forty-one treatments in nine months were required for closure of a large perforation beneath the umbo. Tinnitus was relieved and hearing was somewhat improved (see Fig. 5d).

Case 5: A. V., a 12-year-old boy, had right middle ear infections two to four times a year, usually following swimming. There was a large posterior perforation of the tympanic membrane with a protruding polypoid granuloma. Under treatment the ear became dry and free of granulations in three months. Four cauterizations during the following two months were required for closure of the perforation. During the subsequent nine and one-half months he had no ear infections, although he had been swimming frequently. He has good hearing improvement (see Fig. 5e).

Case 6: A. L., a 23-year-old male, had drainage from both ears two to three times a year since infancy, with subjective hearing loss since the age of 10. There were large central perforations of the tympanic membranes. The clinical impression was bilateral chronic suppurative otitis media with possible loss of part of the ossicular chain on the right side. Eleven months later, after 37 treatments to the right ear and 44 treatments to the left ear, the perforations were almost closed. Paper prostheses placed over the perforations revealed marked improvement in hearing in the left ear and no improvement on the right side, thus indicating the probable audiometric result of complete closure (see Fig. 6).

The cause of failure in three cases is not clear. C. N. was a five-year-old girl in whom accurate application of the acid was impossible, probably accounting for the failure. The margins of the perforations in cases G. J., age 60, and B. O., age 58, failed to respond after a reasonable length of time and treatments were discontinued. Age may have been a factor in the latter two cases.

CONCLUSIONS.

A very old method of repair of perforations of the drum membrane, consisting of repeated applications of trichloracetic acid to the perforation margins, with the proper use of urea solution and removal of marginal exudates, can be successfully used in selected cases.

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SIMULTANEOUS CARCINOMA AND MALIGNANT LYMPHOMA OF THE LARYNX. CASE REPORT AND REVIEW OF LITERATURE.*

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In the course of a routine examination of a larynx removed for carcinoma, we were surprised to find associated with this carcinoma an unsuspected malignant lymphatic tumor.

CASE REPORT.

The patient, a well developed and well nourished 53-year-old white male, gave a history of hoarseness for the past year. His past history was otherwise negative. The examination of the larynx showed a warty growth over the right vocal fold with immobility of this cord. The left vocal cord moved freely and was not involved by the growth. The rest of the larynx appeared normal.

General physical examination disclosed nothing remarkable. Examination of the blood showed 3.93 million erythrocytes per cu.mm., 5.8 thousand leucocytes per cu.mm., and 12.2 gm. of hemoglobin per 100 cc. of blood. Serological examination for syphilis and a routine urinalysis were both negative.

The patient was admitted to the hospital on July 19, 1946. The next day a direct laryngoscopic examination was performed, and two small pieces of tissue were removed from the anterior portion of the right vocal fold. Serial sections of these pieces showed marked chronic inflammation but no evidence of tumor.

On July 25, direct laryngoscopy was repeated and several pieces of tissue were again removed from the anterior portion of the right vocal fold. The sections showed a fairly well differentiated squamous cell carcinoma.

On July 27, a total laryngectomy was performed. The operative procedure was uncomplicated. A small lymph node measuring about 0.6 cm. in diameter was found just anterior to the cricothyroid membrane. A frozen section made on this node was negative for carcinoma. The postoperative course was uncomplicated. On the eighth postoperative day the feeding tube was removed, and on the ninth day the patient was discharged from the hospital in good condition.

Because of the presence of a lymphatic tumor in the specimen (see below), the patient was recommended for X-ray therapy. This irradiation has since been given. When last

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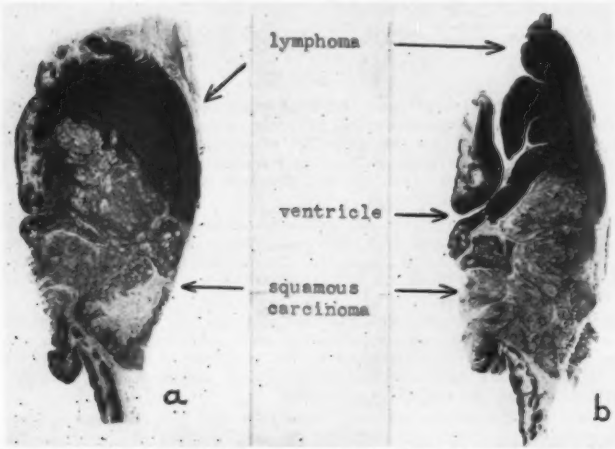
seen on Dec. 18, 1946, the patient showed no evidence of recurrence or of metastasis of either tumor, and no evidence of lymphoma in other parts of the body.

Gross Description of Excised Larynx: The specimen consisted of a larynx without epiglottis. A firm, roughened, ulcerated mass measuring 2 x 3 cm. infiltrated the entire right vocal fold and extended deeply into the soft tissues. The soft tissues above the right vocal fold were edematous,



Figs. 1A and 1B. Logitudinal sections of the right side of larynx showing topography and extent of both tumors. Hematoxylin-eosin stain. Magnification 2¼×. The soft tissues were dissected away from the cartilage after fixation but before imbedding. The lymphoma lies above the squamous tumor. Notice the marked contrast between the two types of tumor and, in Fig. 1B, the thick but smooth folds of the mucosa of the ventricle.

smooth and moderately indurated. The ventricle was distorted but not ulcerated. The rest of the larynx showed no abnormality.

Microscopic Examination: Microscopic examination showed a squamous cell carcinoma of the right vocal fold with extensive ulceration (see Fig. 1). The tumor extended laterally to the inner surface of the thyroid cartilage. Inferiorly the tumor did not extend beyond the level of the lower margin

of the ulceration (see Fig. 1). Superiorly, however, the tumor extended considerably above the level of the rima glottidis, and at one point came within 6 mm. from the cut end of

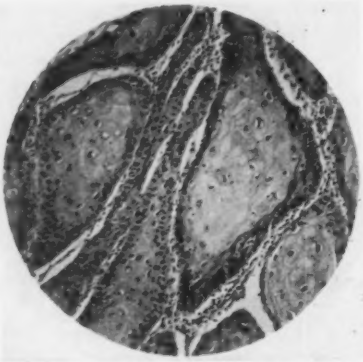


Fig. 2. Photomicrograph of squamous cell part showing the ordinary features of this type of tumor. Hematoxylin-eosin stain. Magnification 92×.

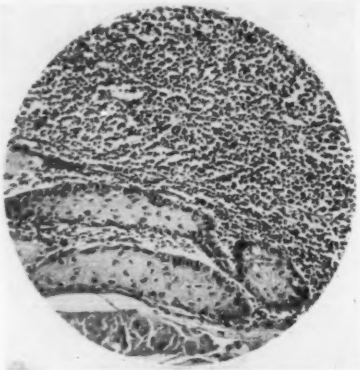


Fig. 3. Photomicrograph at the boundary of both types emphasizing the differences in aggregation and in cell size. Hematoxylin-eosin stain. Magnification 92×.

the specimen (see Fig. 1B). This squamous cell tumor showed the usual features: compact cell masses, intercellular bridges, keratinization (see Fig. 2) and pearl formation.

Above the squamous tumor, practically filling the space not occupied by this tumor (see Fig. 1), there was another tumor with the following characteristics: densely cellular, uniform, nonfollicular (see Fig. 3) and with abundant reticulum (see Fig. 4). The cells were smaller than the squamous cells but were larger than lymphocytes. The cells were in general not round, but angular, elongated or pear-shaped, and many of the cells were attached to reticulum fibrils (see Fig. 5). The amount of cytoplasm was scanty. The nuclei

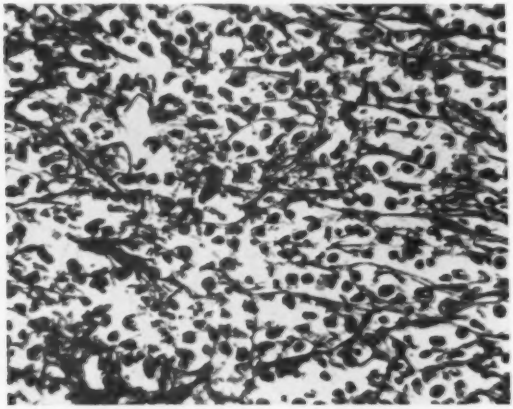


Fig. 4. Photomicrograph of lymphoid part. Wilder's silver impregnation of reticulum. Magnification 378×.

were round to oval. Mitotic figures were not very abundant. Occasional cells were binucleated but there were no giant cells.

This second tumor infiltrated the walls of the ventricle. Because of this infiltration the mucosa of the ventricle was thrown into thick folds (see Fig. 1B). The mucosa of the ventricular fold itself was apparently not involved by the tumor (see Fig. 6). In this part of the mucosa there was a round cell infiltration, a few plasma cells and an occasional lymph follicle, but no tumor. In some sections this tumor reached the upper cut edge of the specimen (see Fig. 1). In all the sections this tumor was confined to the upper part of

the specimen, above the squamous tumor, and it appeared densest in the walls of the ventricle.

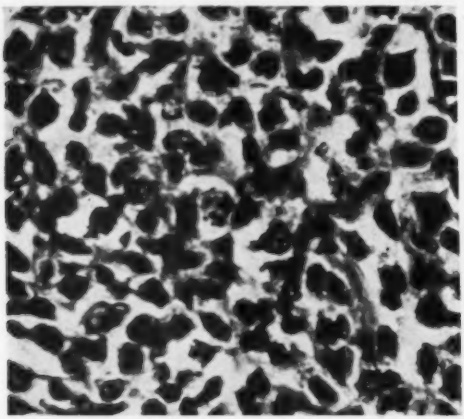


Fig. 5. Photomicrograph of lymphoid part, showing nuclear and cytoplasmic details. Hematoxylin-eosin stain. Magnification 750×.

Fig. 6. Photomicrograph of lymphoid part. Hematoxylin-eosin stain. Magnification 92×. Notice the preservation of the mucosa of the ventricle.

The left side of the larynx showed only a small acute ulceration of the vocal fold.

Paraffin sections of the small lymph node anterior to the cricothyroid membrane showed abundant lymphfollicles. Cellular details were lacking because this node was fixed by boiling in formaldehyde solution for frozen section. Nevertheless, we believe that this follicular hyperplasia was neither a follicular lymphoma nor a metastasis, but only a reactive hyperplasia to the condition of the larynx.

We are of the opinion that the second tumor is a malignant lymphoma originating in the adenoid tissue of the ventricle of the larynx. In type, this lymphoma corresponds to the monomorphic dyctiocytic form of Géry and Bablet.[1] It is probably a less polymorphic variant of the type defined by Gall and Mallory[2] as Hodgkin's sarcoma.

DISCUSSION.

The finding of an unsuspected lymphoma in a larynx removed for an obvious carcinoma emphasizes the value of a careful microscopic examination of the specimen, even when the diagnosis of carcinoma has been established previously by a biopsy.

With respect to the pathologic diagnosis, the co-existence of a squamous tumor and a lymphoid tumor in the same larynx raises the question of lymphoepithelioma (Regaud[3] and Schmincke[4]). Although the description of lymphoepithelioma is not fixed and although the morphological characteristics of this tumor are not agreed upon by all workers, most reports of this tumor conform to the original description of Schmincke,[4] namely, a loose network of syncytial epithelial cells filled more or less densely with lymphocytes. To Schmincke[4] the tumor is essentially an epithelial tumor secondarily involved by lymphocytes. To Géry and Bablet[1] the tumor is a plasmodial lymphatic tumor giving rise, by a kind of "regressive metaplasia," to epithelial masses, even with keratinization, pearl formation, intercellular bridges, etc. In either view the tumor consists of a mixture of the two types of cells. In our specimen the two tumorous elements are in contact with each other in the upper part of the larynx only. Extensive areas of the sections can be separated in which

only one of the two cellular elements is present. For these reasons we feel justified in rejecting the diagnosis of lymphoepithelioma and adopting the alternative view of a double neoplasm.

Lymphoepithelioma of the larynx is very rare. Only one case has come to our attention, the one reported independently by Marx[5] and by Vossenberg.[6] This tumor involved the right pyriform sinus and the aryepiglottic fold, and at the time of the first examination the tumor had already metastasized to the cervical lymph nodes. According to Marx[5] and Vossenberg,[6] the microscopic diagnosis was concurred in by Schmincke.

Primary lymphomas of the larynx are also rare. Mackenzie[7] reported a primary lymphoma of the sinus pyriformis. Ewing[8] cited this case and also a lymphosarcoma of pharynx and larynx (Stoerk[9]). Stout[10] cited a case of Hodgkin's disease involving the larynx before glandular enlargement appeared (Tanturri[11]). Jackson and Jackson[12] stated that they have seen malignant lymphomas of the larynx, but did not give their frequency. Recently, Holmes and Schultz[13] listed a lymphoblastic lymphoma of the larynx which was treated in 1933 with radon seeds. This patient was still alive in 1946.

Plasmocytomas have also been found in the larynx (Boit,[14] Wachter,[15] Bourgeois and Huet[16]). According to Hart and Mayer,[17] there are numerous reports of leucemic infiltrates in the larynx as part of a generalized lymphadenosis or lymphogranulomatosis, with or without leucemia.

Multiple primary cancers are, of course, rare and exceedingly so in the larynx. Warren and Gates[18] reviewed the literature on multiple malignant tumors and added 40 new cases, bringing the total to 1,259. The gastrointestinal tract was involved in 78 per cent of the cases. These authors believe that in about 2 per cent of patients with cancer, there is present more than one primary malignant tumor.

From the standpoint of laryngeal involvement, the multiple primary malignancies which we have found reported in the literature can be grouped as follows:

Group 1: Multiple primary malignant tumors, one of which is in the larynx, the other, or others, in other parts of the body.

Group 2: Multiple primary malignant tumors in the larynx, all of the same general type.

Group 3: Multiple primary malignant tumors in the larynx, each of a different type.

The authors and types of tumors of these groups are presented in Table 1. The case we have reported belongs obviously in Group 3.

SUMMARY.

A case of double primary malignant tumor of the larynx is presented. One tumor is a squamous cell carcinoma of the right vocal fold. The other tumor is a Hodgkin's sarcoma of the right ventricle. The two tumors are in contact with each other in the upper part of the larynx only. Photomicrographs of both tumors are reproduced.

The literature on multiple primary malignant tumors has been reviewed.

A table is presented listing the cases of multiple malignant tumors in which the larynx is involved.

TABLE 1.
GROUP 1.

Beadles[19]—Carcinoma of larynx, carcinoma of esophagus.

Tixier[20]—Carcinoma of larynx, carcinoma of thyroid.

Feilchenfeld[21]—Carcinoma of larynx, carcinoma of stomach.

Haberer[22] — Spindle cell sarcoma of epiglottis, carcinoma of base of tongue.

Götting[23]—Squamous cell carcinoma of larynx, adenocarcinoma of rectum, medullary carcinoma of stomach.

Nobiling[24]—Carcinoma of larynx and both seminal vesicles.

Ziba[25]—Carcinoma of larynx, carcinoma of esophagus.

Mielecki[26]—Squamous cell carcinoma of larynx, carcinoma of stomach, adenocarcinoma of rectum.

Grivot, Leroux and Caussé[27]—Epidermoid carcinoma of larynx, lymphosarcoma of base of tongue.

Ophuls[28]—Carcinoma of larynx, carcinoma of pharynx.

Junghanns[29]—Carcinoma of larynx, carcinoma of stomach.

Wilbur[30]—Basal cell carcinoma of larynx, basal cell carcinoma of esophagus.

Forschner[31]—Epidermoid carcinoma of larynx, epidermoid carcinoma of lip.

Hanlon[32]—Epidermoid carcinoma of larynx, adenocarcinoma of ileum.

Kocka[33]—Papillocarcinoma of larynx, cancroid of nose.

Laub and Zalka[34]—Squamous cell carcinoma of larynx, oat cell carcinoma of bronchus.

GROUP 2.

Honcamp[35]—Three squamous cell carcinomas in same larynx.

GROUP 3.

Sikl[36]—Squampus cell carcinoma of larynx. Glandular adenocarcinoma of larynx.

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THE REPORT OF A CASE OF CLOSURE OF A POSTAURICULAR MASTOID FISTULA.

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A postauricular mastoid fistula following a simple or radical mastoidectomy is not a too common complication; however, when it does occur it may afford some difficulty in permitting proper closure.

The fistula is usually the result of prolonged drainage from a mastoid wound which has failed to fill in and heal properly, leaving a depression and a moderate to large sized opening leading into the mastoid antrum or external auditory canal. Whether the prolonged drainage is due to improper postoperative care or to remaining infected mastoid cells is a debatable point. Both probably are factors in the etiology.

There have been numerous techniques described, ranging from simple skin closure with or without flaps to closure with fascial or muscle flaps. Successful results have been reported with all of these methods; however, in cases where the fistula is closed by resuture of the skin, with or without use of a flap, one is still left with the postauricular depression. Muscle and fascial flaps have also been used successfully. The disadvantage here lies in the relatively difficult technique and in the bloodiness of the entire procedure. Often, too, these types of cases are complicated by a moderate degree of postoperative discomfort.

The following case illustrates another approach to the surgical problem of closure of postauricular fistula. It is a relatively simple procedure, can be done under local or general anesthesia and gives a good cosmetic and functional result.

The technique, in brief, consists of a revision of the mas-

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toid cavity and the filling of the cavity with cancellous bone chips taken from the crest of the ilium.

The idea of filling the mastoid cavity with bone chips is not new or original. In 1918, Eagleton reported the use of tibial bone transplants in filling a mastoid cavity. His idea, however, was to reconstruct the mastoid area at the time of the mastoidectomy and thus eliminate painful dressings.

In the past decade the use of cancellous bone had been popularized in British plastic surgical centers, and recently it has been successfully utilized on this continent. Mowlem reported the use of cancellous bone chips for the restoration of contour in skull and face depressions and for the restoration of continuity in fractures of the mandible and long bones such as the tibia.

Mr. A. R. McIndoe, consultant in plastic surgery to the R. A. F., used cancellous bone chips extensively and successfully in his plastic surgical center at East Grimstead, Sussex. I had the privilege of observing the excellent work that was being done at this center.

When called into consultation regarding the case to be presented, the use of bone chips suggested itself as a good method to fill in the postauricular depression after the revision of the mastoid.

The following is the case report:

A. C. G., white male, age 25. Patient was admitted to D. L. H. in November, 1945. The records arriving with the patient revealed that he had had a left cortical mastoidectomy in India, on Feb. 11, 1945. The postauricular wound had failed to heal and a fistulous tract leading to the antrum had resulted.

On admission the following were the complaints: Deafness; discharge from auditory canal and from postauricular opening; a sense of imbalance when postauricular opening was not kept covered.

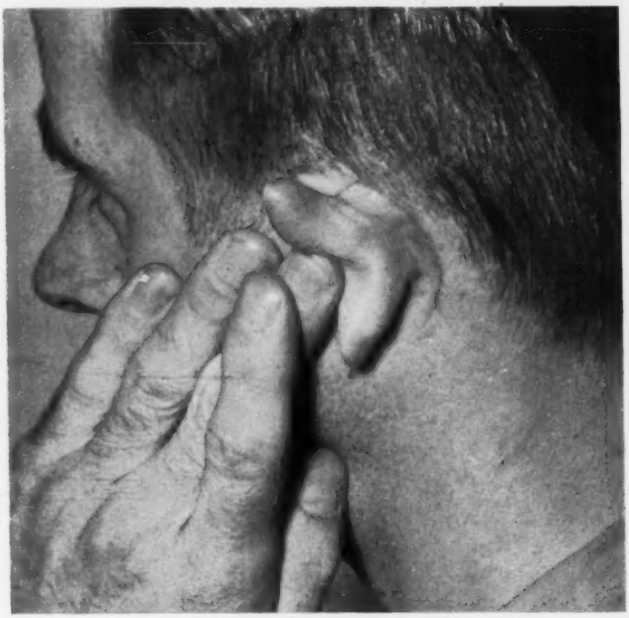
The examination at this time revealed the following positive aural findings: A postauricular fistula, one-half inch in width, at the skin surface leading to the mastoid antrum; a marked depression over mastoid area; a moderate amount of mucopurulent discharge in the auditory canal and in the fistulous tract; granulation tissue in auditory canal and in fistulous tract; a postsuperior perforation in tympanic membrane; Eustachian tube was patent; Rinne negative with a markedly reduced air conduction; C. V. was nil. A positive fistula sign could not be elicited.

He was treated conservatively from November to March with dry mopping of canal and chemical cauterization of granulation tissue. A

small wad of cotton was kept over external opening of fistula. This apparently was sufficient to prevent any sensation of imbalance.

I saw him in consultation in March, 1946, and recommended closure of the fistula; however, he developed a pneumococcal pneumonia, from which he convalesced very slowly. It was not until June that he was declared fit for operation.

On June 12, under cyclopropane intratracheal anesthesia, the mastoid cavity was revised. The postauricular scar was excised, the fistulous tract was curetted, the antrum cleared of granulation tissue and the skin was widely undermined.



The dura was found exposed to the extent of about one-half inch.

Small cancellous bone chips were taken from the crest of the ilium and the mastoid cavity was filled so as to correct the mastoid bulge. One flat chip was placed against the dura and another at the entrance to the antrum. Penicillin and sulfathiazole powder were sprayed into the operative area and the skin was then sutured without tension. A one-half inch Penrose drain was inserted at the lower end of the wound and a loose one-half inch gauze packing was inserted into the auditory canal. A firm pressure pad was placed over the mastoid area and the usual bandage applied.

On June 14, 1946, the Penrose drain was removed and the dressing

changed. The patient felt well and volunteered the statement that he could move his head without getting dizzy.

June 17, 1946: The sutures were removed. The postauricular wound was well approximated and healed by first intention. There was still a moderate amount of mucopurulent discharge in the canal. He was able to be up and about without any great discomfort.

June 24, 1946: The ear was dry. The tympanic membrane was white and the perforation appeared to be healing. The patient was discharged to a rehabilitation center.

He was seen again on Aug. 26. He looked fit and had put on weight. The ear was dry, the perforation healed and the postauricular area was of good contour and scar was well healed.

A definite and positive conclusion should not be drawn from one case; however, it is suggested that a postauricular fistula with a depression deformity can be corrected by a relatively simple procedure which will give a good cosmetic and functional result with only minimal postoperative reaction.

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